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Ventilation Laws

in the United States

Also Board of Health Requirements and Regulations of
National Board of Fire Underwriters.

Together with Model Ventilation Requirements as
Promulgated by The American Society of
Heating and Ventilating Engineers.

Third Revised Edition

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PRESENT STATUS OF COMPULSORY VENTILATION

- Alabama—No law.
Arizona—No law.
Arkansas—No law.
California—No law, except general law for factory buildings.
Colorado—No law.
Connecticut—State Board of Health rulings in force.
Delaware—No law.
Idaho—No law.
Illinois—Laws in effect covering all classes of buildings.
Indiana—Laws in effect covering all classes of buildings.
Iowa—No law, except for factories.
Kansas—Laws in effect covering factories and theatres.
Kentucky—No law.
Louisiana—State Board of Health rulings in force.
Maine—Partial requirements set forth by State Superintendent of Public Schools.
Maryland—No law.
Massachusetts—Law in effect covering all classes of buildings.
Michigan—No law, except for grinding and polishing machinery.
Minnesota—State Board of Health requirements in force, covering public school buildings.
Mississippi—No law.
Missouri—No law.
Montana—Law in effect covering public school buildings.
Nevada—No law.
New Hampshire—No law.
Nebraska—No law.
New Jersey—Law in effect covering public school buildings and exhaust systems in workshops.
New Mexico—No law.
New York—Laws in effect covering all classes of buildings.

North Carolina—No law.

North Dakota—Law in effect covering public school buildings.

Ohio—Laws in effect covering all public buildings and factories.

Oklahoma—No law.

Oregon—No law.

Pennsylvania—Law in effect covering public school buildings, and grinding and polishing machinery.

Rhode Island—No law.

South Dakota—No law.

South Carolina—No law.

Tennessee—Law in effect covering workshops and factories.

Texas—No law.

Washington—No law.

Wyoming—No law.

Utah—Law in effect covering public school buildings.

Virginia—Law in effect covering public school buildings.

West Virginia—No law.

Wisconsin—General orders in effect of State Industrial Commission regarding grinding, buffing and polishing machinery.

CONTENTS.

	Page
CALIFORNIA: General Factory Ventilation Law.....	108
San Francisco ordinance	7
COLUMBIA, DISTRICT OF: Practice of Municipal Archi- tect	8
CONNECTICUT: State Board of Health Requirements..	9
FLORIDA: State Board of Health Requirements.....	10
ILLINOIS: Factory Ventilation Law.....	109
Requirements for Public School Buildings.....	11
Chicago Ventilation Code.....	17
Ventilation of Chicago Street, Elevated and Sur- face Cars	22
INDIANA: State Board of Health Requirements.....	25
Law for Ventilation of Industrial Buildings.....	113
KANSAS: Picture Show Ventilation Law.....	34
IOWA: Laws for Exhausting Systems.....	113
KANSAS: Factory and Picture Show Ventilation Law.	114
LOUISIANA: State Board of Health Requirements....	37
MAINE: Requirements of State Superintendent of Public Schools	39
MASSACHUSETTS: Ventilation Law.....	41
Requirements of Massachusetts District Police...	44
MICHIGAN: Law for Exhaust Systems.....	117
Detroit Ventilation Ordinance	50
MINNESOTA: Requirements of State Superintendent of Education	53
General Factory Ventilation Law.....	117
MONTANA: Ventilating Provisions of School Law....	61
NEW JERSEY: Public School Ventilation Law.....	62
Law for Exhausting Systems	118

CONTENTS

NEW YORK STATE: Ventilation Law	64
New York State Industrial Board	120
New York State Factory Ventilation Law, Prac- tical Requirements of.....	125
NORTH DAKOTA: Ventilation Provisions of State Pub- lic School Law.....	66
OHIO: State Building Code	69
Laws Governing Factory and Building Inspection..	131
Heating and Ventilating Sections of Cleveland's Building Code	79 and 133
OREGON: Portland's Building Code	83
PENNSYLVANIA: Public School Ventilation Law....	84
Requirements Regarding Blowers and Exhausters.	135
Philadelphia, Requirements of engineering depart- ment of Board of Education	85
TENNESSEE: Portion of Sanitary Food Law Contain- ing Ventilating Requirements for Food Shops..	86
UTAH: Public School Ventilation Law.....	89
VERMONT: State Board of Health Requirements.....	91
VIRGINIA: Public School Ventilation Law	97
WISCONSIN: Requirements for Exhausting Ma- chinery	135
REGULATIONS OF THE NATIONAL BOARD OF FIRE UNDERWRITERS FOR THE INSTALLATION OF BLOWER SYSTEMS	98
REQUIREMENTS FOR THE HEATING AND VENTILATION OF INDUSTRIAL BUILDINGS.....	108
PROPOSED SMOKE PREVENTION CODES FOR LARGE AND SMALL CITIES.....	137
REQUIREMENTS FOR MODEL COMPULSORY HEATING AND VENTILATION LAWS.....	145

Ventilation Laws

CALIFORNIA

There is no State law in California regulating the heating and ventilating requirements of public buildings.

In San Francisco, a section has been added to Ordinance No. 1008, known as the building law, adopted May, 1911. This section is as follows:

In all buildings which are designed to be used in whole or in part, as public buildings, public or private institutions, school house, church, public place of assemblage, or place of public resort, and all buildings which are designed to be used in whole or in part as a factory, workshop, mercantile or other establishment, and with accommodations for ten or more employees, provision shall be made for at least 15 sq. ft. of floor space and 200 cu. ft. of air space for each occupant to be accommodated in each room therein, and for supplying at least 30 cu. ft. of pure air per minute for each occupant thereof.

In every building, or part of building, intended for audience room only, as a theatre, hall or nickelodeon, provision shall be made for supplying at least 30 cu. ft. of pure air per minute for each occupant thereof.

DISTRICT OF COLUMBIA

The District of Columbia has no adequate law regarding the heating and ventilation of buildings. However, the municipal architect of the District of Columbia states, under date of March 16, 1914:

"My practice is to provide not less than 30 cu. ft. of air per minute per pupil in the classrooms, and to maintain a constant temperature (generally 70° F.) throughout the school sessions.

"The method used is that of indirect heating, the air being admitted into classrooms at such locations and velocity as to eliminate the possibility of drafts on pupils. Each schoolroom is provided with adequate ventilation for removing the foul air from room as continuously as the fresh air is admitted, without the necessity of using the windows.

"The requirements noted above were in general contained in the report of the commission appointed by resolution of the House of Representatives, of February 20, 1882. (Misc. Doc. No. 35.)"

CONNECTICUT

There is no law now in effect in the State of Connecticut relating to the ventilation of public buildings, except the Revision of the General Statute 1902, paragraph 2505 under the caption of "Duties of the State Board," in which will be found the following: "Said Board shall take cognizance of the interests of health and life among the people of this State; shall make sanitary investigations and inquire respecting the causes of disease. Shall cause to be made by the secretary, or by a committee of the Board of Inspections, at such times as it may deem best and wherever directed by the Governor or the general assembly, investigations of all public hospitals, prisons, asylums or other public institutions in regard to the location, drainage, water supply, disposal of excreta, heating and ventilation and other circumstances in any way affecting the health of the inmates."

A regulation of the Board of School Visitors in Hartford, Conn., requires forced draft ventilation, for public school buildings in that city, with a minimum of 1,800 cu. ft. of pure air per hour per pupil, and "facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes."

FLORIDA

The rules and regulations of the State Board of Health (Publication 92) contain the following provision under the heading of sanitation of public buildings:

Rule 39. Ventilation—All churches, halls, theatres and other buildings used for public meeting should be kept at all times in a clean and sanitary condition. Every such building should be provided with proper method for maintaining the purity of the atmosphere and such methods should be employed at all times. The same publication contains extracts from the general statutes of Florida relating to public health and the powers and duties of the State Board of Health. The general powers of the board are defined as covering the general supervision of the public health of the State of Florida, and shall have power to make, promulgate and enforce such rules and regulations as may be necessary for the preservation of same.

In connection with the sanitary inspection of hotels and boarding houses, the Board of Health is empowered to make examinations covering among other things "The Ventilation Obtainable."

ILLINOIS

REQUIREMENTS FOR PUBLIC SCHOOL BUILDINGS IN ILLINOIS

Notable amendments to the Illinois School Law, passed in 1915, materially affect the requirements for the heating and ventilation of public school buildings, as well as the lighting, seating, water supply, toilets and safety against fire in the public schools. Attention is called to the fact that in the case of new or remodeled buildings the law went into effect at once. But for buildings already in use the penalties cannot be enforced until March 1, 1917. School officers are advised to begin at once and do what can best be done now. By March 1, 1917, they must be able to meet all the requirements of the law.

THE NEW LAW

The requirements in question are contained in Sections 3, 15, 35 and 114-119 of the "School Law Relating to the Sanitary Conditions of School Buildings." The extracts mentioned as well as the specifications for the minimum requirements for heating, ventilation, etc., are published as "Circular No. 88" by F. G. Blair, state superintendent of public instruction.

Section 3, Paragraph 13, states that it is "the duty of the superintendent of public instruction to prepare, with the advice of the State Board of Health, the state architect and the state fire marshal, for school directors and boards of education, specifications for the minimum re-

quirements for the heating, ventilation * * * which will conserve the health and safety of the children attending the public schools."

Under Section 15, devoted to the "duty of the county superintendent of schools," it is stated that "the duty of the county superintendent of schools shall be to inspect the plans and specifications for the heating, ventilation, lighting, seating, water supply, toilets and safety against fire for public schoolrooms and buildings submitted to him by boards of education or boards of directors, and to approve all those which comply substantially with the specifications prepared and published by the superintendent of public instruction."

Also "to inspect all public schools under his supervision and notify in writing before the first day of April the board of school trustees, or other boards exercising similar functions, whether the several schools in their jurisdiction have or have not been kept as required by law."

Provision is made for the condemnation of such buildings if they are found not to come up to the requirements in any way. There is also a clause which provides for the withholding of the part of the distributive funds apportioned to the various school districts in cases where the requirements are not met.

Regarding the submission of plans, it is specified in Sections 114-119 that "before erecting or remodeling a public school building the board of directors or the board of education in districts containing fewer than 100,000 inhabitants shall submit plans and specifications respecting heating, ventilation, etc., to the county superintendent for his approval.

MINIMUM REQUIREMENTS

Acting under the law, Francis G. Blair, state superintendent of public schools, has made out a set of standard minimum requirements, the principal items of which are given herewith:

ROOM HEATERS AND VENTILATORS.

In connection with the requirements where room heaters are used, it is provided that the cross-sectional area of the opening into the foul air vent shall be equal to that of the cross-sectional area of the fresh air opening. All classrooms must have at least 16 sq. ft. of floor space and not less than 200 cu. ft. of air space per pupil.

FRESH AIR DUCTS AND VENT FLUES

A. When the foul air is taken out through the smoke flue:

	Cubic Feet in Room	
	8,000 or less	More than 8,000
	Sq. in.	Sq. in.
Cross-sectional area of smoke flue not less than.....	192	256
Cross-sectional area of foul air vent into chimney not less than.....	192	256
Cross-sectional area of fresh air intake not less than.....	180	240

B. When the foul air is taken out through a flue separate from the smoke flue:

	Cubic Feet in Room	
	8,000 or less Sq. in.	More than 8,000 Sq. in.
Cross-sectional area of smoke flue not less than.....	96	96
Cross-sectional area of foul air vent flue not less than.....	192	240
Cross-sectional area of fresh air intake not less than.....	180	240
The cross-sectional area of the vent flue shall be at least equal to the openings specified above.		

BASEMENT HOT AIR FURNACES

When a basement furnace is used there shall be an intake for fresh air from outside the building and also a cold air intake from inside the schoolroom. Dampers shall be provided which will make it possible to take all the air from one source or to take a part from both sources at the same time.

The chains which regulate the dampers for the admission of air to the furnace and those which control the drafts of the furnace shall extend into the schoolroom.

There shall be an entrance to the basement from within the building as well as from without.

The floor of the basement shall be concrete or brick.

Warm air from the furnace shall be admitted into the room at the wall at least 6 ft. above the floor.

The opening into the foul air flue shall be at the floor level and the foul air flue shall be so constructed that it will be heated by the smoke flue.

The return cold air opening from the room as well as the opening from the outside shall be at the same wall

as the warm air inlet and shall be 2 in. above the floor level. The grating over this opening shall be leaned against the wall at an angle of 45° . The openings from the outside and the inside shall connect with the duct to the furnace. The damper shall be constructed so as to close either opening and leave the other open.

A foot warmer or warm air register shall be placed at the floor level in the wall. No warm or cold air register shall be placed in the floor where it can be walked on or sweepings fall into it.

STEAM HEATING

The Fan System—When the fan system of ventilation is used, the warm air flues shall have a cross-sectional area of not less than 9 sq. in. for each occupant of the room. The vent flues shall have a cross-sectional area of not less than 10 sq. in. for each occupant of the room.

The Gravity System—Where the gravity system of ventilation is used the warm air flues shall have a cross-sectional area of not less than 16 sq. in. and the vent flues 14 sq. in. for each occupant of the room.

Air Passed Through Radiators—When fresh air is taken directly into the room and passed through the radiators, the combined cross-sectional area of all the openings shall be not less than 9 sq. in. and that of the vent flue not less than 10 sq. in. for each occupant of the room.

When the methods mentioned in the last two paragraphs are used, each foul air flue shall be provided with a radiator of at least 9 sq. ft. of radiating surface.

Moistening the Air—In all systems of heating ample provision shall be made to moisten the heated air.

The county superintendents will be called on to fill out a definite report covering some fifty separate items, including measurement of the floor space, cubical contents,

window space, sizes of ventilating flues, etc. After his inspection, he is to be provided with a score card which he is to fill out, showing the points that are unsatisfactory as well as his suggestions for improving them.

(See also Heating and Ventilating Requirements for Industrial Buildings on Page 109.)

Chicago

In the Sanitary Code of Chicago, as passed in 1911, the following requirements relate to the ventilation of buildings:

ARTICLE XX

VENTILATION

680. *VENTILATION IN BUILDINGS OF CLASSES IV, V, VII and VIII.*

(a) The air used in any room used as an auditorium in buildings of Classes IV and V, hereafter erected, and the air in any room used as an auditorium in buildings of Classes IV and V hereafter erected, and the air in any room used as a classroom or assembly hall in buildings of Class VIII, hereafter erected, shall be changed, so as to provide each person for whom seating accommodation is provided in such auditorium, classroom or assembly hall with at least 1,500 cu. ft. of air per hour.

(b) In buildings of Class VII hereafter erected on floors frequented by the public the air in such rooms shall be supplied at the following rates:

For each person in basement, 2,000 cu. ft. per hour.

For each person in first to third stories, both inclusive, 1,500 cu. ft. per hour.

For each person in fourth story and above, except as hereinafter provided, 1,300 cu. ft. per hour.

For each person in grocery departments and restaurants, 1,500 cu. ft. per hour.

(c) For the purpose of determining the number of

people on any floor in buildings of Class VII, in calculating the means of ventilation, the following floor area per person per floor shall be taken as the basis:

Basement, per person, 20 sq. ft. of floor area, exclusive of walls, stairs and elevators.

First story, per person, 20 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows.

Second story, per person, 50 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows.

Third story, per person, 60 sq. ft. of floor area, exclusive of walls, stairs and elevators.

Fourth story and above, per person, 80 sq. ft. of floor area, exclusive of walls, stairs and elevators, except as hereinafter provided.

(d) Grocery departments and restaurants, per person, 40 sq. ft. of floor area, exclusive of walls, stairs and elevators.

(e) The amount of carbon dioxide in the air of any such auditorium, classroom or assembly hall or space frequented by the public in Class VII buildings shall not be permitted to rise above 10 parts of carbon dioxide per 10,000 parts of air, measurements being taken at levels from $2\frac{1}{2}$ ft. to 8 ft. above the floor, generally distributed, and the temperature in such spaces when artificially heated shall not exceed 68° F. Relative humidity shall not be less than 45% nor more than 80%.

(f) The air in any room used as an auditorium in buildings of Classes IV and V constructed prior to the passage of this ordinance, and the air in any room used as a classroom or assembly hall in buildings of Class VIII constructed prior to the passage of this ordinance shall be changed so as to provide each person for whom seating accommodation is provided in such auditorium, classroom

or assembly hall with at least 1,200 cu. ft. of air per hour.

(g) The air in any rooms and floors in buildings of Class VII erected prior to the passage of this ordinance shall be supplied by mechanical or other means, at the following rates:

For each person in basement, 1,600 cu. ft. per hour. For each person in first to third stories, both inclusive, 1,200 cu. ft. per hour. For each person in fourth story and above except as hereinafter provided, 1,040 cu. ft. per hour. For each person in grocery departments and restaurants, 1,200 cu. ft. per hour.

(h) For the purpose of determining the number of people on any floor in buildings of Class VII, in calculating the means of ventilation, the following floor area per person per floor shall be taken as the basis:

Basement, per person, 20 sq. ft. of floor area, exclusive of walls, stairs and elevators. First story, per person, 20 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows. Second story, per person, 50 sq. ft. of floor area, exclusive of walls, stairs, elevators and enclosed show windows. Third story, per person, 60 sq. ft. of floor area, exclusive of walls, stairs and elevators. Fourth story and above, per person, 80 sq. ft. of floor area, exclusive of walls, stairs and elevators, except as hereinafter provided. Grocery departments and restaurants, per person, 40 sq. ft. of floor area, exclusive of walls, stairs and elevators.

(i) The amount of carbon dioxide in the air of any such auditoriums, classrooms or assembly hall or space frequented by the public in Class VII buildings shall not be permitted to rise above 12 parts of carbon dioxide per 10,000 parts of air, measurements being taken at levels from $2\frac{1}{2}$ to 8 ft. above the floor generally distributed;

and the temperature in such spaces when artificially heated shall not exceed 70° F. The relative humidity shall not be less than 40% nor more than 85%.

(j) The word "auditorium" as used in this section in connection with buildings of Classes IV and V shall be constructed as including the main floor, balcony and galleries.

(k) In buildings hereafter erected for or converted to the use of a factory, mill or workshop the air shall be changed, except as hereinafter provided, so as to provide each person for whom working accommodations are provided therein with at least 1,500 cu. ft. of air per hour.

(l) In buildings used for the purpose of a factory, mill or workshop at the time of the passage of this ordinance the air shall be changed, except as hereinafter provided, so as to provide each person for whom working accommodations are provided therein with at least 1,200 cu. ft. of air per hour.

(m) In any building or room hereafter erected for or converted to the use of a factory, mill or workshop, the amount of carbon dioxide in the air, except as hereinafter provided, shall not be permitted to rise above 10 parts of carbon dioxide per 10,000 parts of air.

(n) In buildings or rooms used for the purpose of a factory, mill or workshop at the time of the passage of this ordinance, the amount of carbon dioxide in the air, except as hereinafter provided, shall not be permitted to rise above 12 parts of carbon dioxide per 10,000 parts of air. The measurements in each case above enumerated in this paragraph shall be taken at the levels from 2½ to 8 ft. above the floor, distributed generally; and the temperature in such spaces when artificially heated, shall not exceed 68° F., except as hereinafter provided; the relative humidity shall not be less than 40%, nor more than 85%.

(o) The above provisions and standards as to ventilation shall not apply to storage rooms or vaults, or any place where the manufacturing process therein conducted would be materially interfered with, or where the manufacturing processes therein conducted would produce considerable quantities of free carbon dioxide, except that the air in such rooms or vaults or in any places of manufacture shall not be permitted to become detrimental to the health of those who enter or work therein.

(p) No part of the fresh air supplied in compliance with the requirements of this section shall be taken from any cellar or basement.

(q) No person, firm or corporation, either as owner, proprietor, lessee, manager or superintendent of any factory, mill, workshop or any other building where one or more persons are employed shall cause, permit or allow the same or any portion or apartment of any room in such factory, mill or workshop, to be overcrowded or to have inadequate or insufficient light or ventilation.

(r) No person shall be exposed to any direct draft from any air inlet, nor to any draft having a temperature of less than 60° F.

(s) All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the persons employed, which is created in the course of a manufacturing process, within such factory, mill, workshop or laundry, shall be removed, as far as practicable, by either ventilating or exhaust devices.

Under Article XXIV, Section 1399, relating to the ventilation of stores, factories, workshops, etc., it is stated that "no person, being the owner, proprietor, lessee, manager or superintendent of any store, factory, workshop or other structure or place of employment where work-

men and workwomen are employed for wages, shall cause, permit or allow the same or any portion or apartment of, or any room in such store, factory, workshop or other structure or place of employment, to be overcrowded or inadequate, faulty or insufficient in respect of light, ventilation, heat and cleanliness; and in every such building or apartment, or room in any such building, where one or more persons are employed as aforesaid, at least 500 cu. ft. of air space shall be allowed to each and every person employed therein, and fresh air supplied by ventilation at the rate of four complete changes of air per hour during the hours of employment. No part of such air supply shall be taken from any cellar or basement.

Ventilation of Street, Elevated and Subway Cars.

Under Chapter LIX, of the Chicago Sanitary Code, are given complete regulations for the heating and ventilation of the street, elevated and subway cars in that city.

The full requirements are contained in Section 2210 and 2211, as follows:

2210. *Comfort and safety of passengers.* It shall not be lawful for any person or corporation owning, leasing or operating any street railway cars or steam railroad cars, which run from point to point within the city of Chicago, either on elevated, surface or subway lines, to permit any car to be used or operated on any of the public streets or ways of said city unless the following conditions are complied with:

(a) There shall be maintained within such car an average temperature not lower than 50° F., nor (when such car is heated by artificial heat) higher than 75° F.

(b) There shall be maintained and conspicuously displayed in such car a standard Fahrenheit thermometer so

located that it will furnish a fair criterion of the temperature of the car.

(c) The car shall be so ventilated that the amount of air entering the car for ventilation, through openings provided for such purpose, shall be at the rate of 350 cu. ft. for each passenger per hour, based on the maximum carrying capacity (seats and standing room included) of such car; provided, however, that the carbonic acid present in the air of the car shall not exceed 10 parts in each 10,000 parts of air.

(d) The air for ventilating purposes shall be delivered within the car at a point below the average level of the heads of the seated passengers, and the exits for foul air shall be located and maintained at a point above the heads of the standing passengers; the openings of the air intakes shall be so constructed and maintained as to be protected from dust and dirt.

(e) Cars or portions of cars in which smoking is permitted shall be provided with a ventilating capacity 33 1/3% in excess of the capacity required for other cars or the portions of cars in which smoking is not permitted.

(f) The radiation in such cars shall be so placed with reference to the air currents as to diffuse the heat throughout the car.

* * * * *

(l) No open cars shall be used or operated within said city upon any day between the first day of October and the first day of May in any year, when the temperature in the open air is lower than 50° F.

(n) There shall be securely posted in each car, where it may be conveniently read by passengers, a copy of this section.

The provisions of this ordinance relating to the main-

tenance of the temperature, the maintenance of the thermometers and the posting of copies of this section within said cars, as herein provided, shall not apply to open cars operated at any time not prohibited by this section.

After this section shall take effect, the commissioner of health shall detail employes from the department of health to make the investigation necessary to determine whether or not the sanitary provisions of this section are being complied with, and the said commissioner shall report the result of such investigation to the corporation counsel. It is hereby made the duty of the local transportation except to secure information necessary to determine whether or not all other provisions of this section are being complied with and to cooperate with the corporation counsel in securing the evidence necessary to the prosecution of violations of this section.

2211. *Penalty.* Any person, firm, company or corporation who shall be guilty of violating any of the provisions of the preceding section shall be fined not less than \$25.00 nor more than \$100.00 for each car operated in violation of this law, and each day of the operation of such car shall be considered a separate offense.

INDIANA

Rules and regulations governing the construction, equipment and maintenance of sanitary features of public and parochial school buildings were passed by the Indiana State Board of Health, December 17, 1913. These rules and regulations have all the force of law, the State Board being empowered, among other things, to "regulate and prescribe the character and location of plumbing, drainage, water supply, lighting, heating and ventilation, and all sanitary features of all public buildings and institutions, * * * and any violation of said rules shall be punished by a fine of not less than five nor more than fifty dollars for each offense." (Chapter 144, Acts 1909, Part of Section 6.)

The rules take up the site for school buildings, followed by construction features. In connection with the size of classrooms, it is provided that no classroom shall exceed 25 ft. in width. The ceiling shall be not less than 12 ft. nor more than 13 ft. in height. Wood ceilings shall not be used.

The provisions covering heating and ventilation are extensive and include both the requirements and the methods of fulfilling such requirements. They are as follows:

Heating and Ventilation: Heating and ventilating systems of all kinds shall take fresh air from outside the school building, evenly diffuse the same throughout each schoolroom during school session and withdraw foul air from said schoolroom at a minimum rate of 1,800 cu. ft. per hour for each 225 cu. ft. of said schoolroom space, regardless of outside atmospheric conditions.

a. Test—The State Board of Health will test the efficiency of ventilating systems in school buildings as follows: With jacketed heaters and gravity systems, the anemometer test shall be made over the foul air vents in classrooms. With plenum systems, the anemometer test shall be made over the fresh air inlet of the fresh air room and the fresh air inlet in classrooms. With a double system of mechanical ventilation, the anemometer test shall be made at the fresh air intake and at the foul air vents in classrooms. In every test five readings shall be taken, one near each corner and one at the center of the air-opening to be tested. A deduction of 5% shall be made for a grill or register in the air opening. All tests shall be based upon the seating capacity of classrooms at 225 cu. ft. of space per pupil. Before such test shall be made by the State Board of Health, the heating and ventilating contractor shall be given notice of the time when such test is to be made. The State Board of Health will make such tests upon the written request of trustees, school boards, boards of school commissioners, county, city or state superintendents, or upon petition of ten or more patrons of the school.

Plenum and Gravity Systems of Ventilation:

In plenum or blast systems of ventilation, the warm air flues shall have a cross-sectional area of not less than 10 sq. in. for each pupil, based on the seating capacity of the room. The vent flues shall have a cross-sectional area of not less than 10 sq. in. for each pupil, based on the seating capacity of the room.

In gravity systems of ventilation, the warm air flues and vent flues shall each have a cross-sectional area of not less than 16 sq. in. for each pupil, based on the seating capacity of the room.

a. **Flue and Vents**—In school buildings of more than one room with plenum or gravity ventilation the warm air flues and vent flues shall be on or in the inside walls of the building, and the warm air inlets and the foul air vents shall be on the same side of the room. Warm air inlets shall be located not less than 5 ft. from the floor. Wire screens of No. 8 gauge wire with 1½-in. mesh may be used to cover the warm air inlets, except in rooms of such size and shape as to require the air to be deflected, in which case diffusers may be used. Foul air vents shall be at the floor level, shall have a free area of not less than the cross-sectional area of the flue, and shall be clear of all obstructions. Grills or registers shall not be used in foul air vents except with jacketed heaters. A chain damper, or other approved device, in plain view and easily accessible from inside the room or a chain damper in the foul air chamber in the attic, shall be used to close the vent when not in use. The damper shall be kept open at all times when school is in session. The floor and baseboard shall be carried into the bottom of vent flues, and that part of the flue exposed to view shall be plastered and finished the same as the walls of the room.

Reheated Air: No used air shall be reheated except as provided under jacketed heaters and floor furnaces, or except where an air washing system has been installed, and such system of rewashing and reheating air has been approved by the State Board of Health.

Foot Warmers: So-called foot warmers, if used, shall be placed in the walls of the main corridors at the floor level. No register of any kind shall be placed in the floor in any school building.

Air Supply:

a. In gravity or plenum systems of ventilation, except where wall openings directly into schoolrooms are used, the air supply shall be taken from outside the building through a window or windows into a room in the basement especially constructed for this purpose, with tight fitting door, impervious and smooth walls, floor and ceiling, to be known as the fresh air room. The window or windows in the outer wall of the fresh air room shall have a free area not less than the combined cross-sectional area of all the warm air supply ducts, and shall be covered with a substantial wire screen of not more than $\frac{1}{2}$ in. mesh and shall be kept free from obstruction. This fresh air room shall be kept clean and free from obstruction at all times. In no case shall basement air be permitted to enter the air supply.

b. In gravity systems where wall openings directly into classrooms are used, the fresh air supply shall be from outside the building, and the combined free cross-sectional area of fresh air intakes shall be not less than the cross-sectional area of foul air flue. Such fresh air intakes shall be provided with an approved damper with operating device in plain view and easily accessible from inside the room. The damper shall be kept open at all times when school is in session. The outside openings of such fresh air intakes shall be covered with substantial wire screen of not more than $\frac{1}{2}$ -in. mesh, and shall be properly protected from rain or snow.

It is recommended that wall-box ventilation shall not be installed in buildings of more than ten rooms.

c. With jacketed heaters the fresh air supply shall be from outside the building, and the fresh air duct shall be

provided with an approved damper with operating device in plain view, and easily accessible from inside the room.

d. No fresh air opening or foul air vent in connection with any system of ventilation shall be kept closed at any time when school is in session.

INSTALLATION

No part of the machinery, shafting, or pulley arrangement of heating and ventilating apparatus or water works system shall be connected to the joist or flooring above the room in which such machinery or apparatus is installed.

ASPIRATION IN VENT STACKS

All masonry flues shall start upon substantial foundation at the ground. All vent flues shall be carried through the attic and above the highest point of the roof, either as separate flues or by being combined into one or more foul air chambers in the attic. Each foul air chamber shall be provided with proper roof openings and shall be equipped with proper cowls or ventilators to prevent draught. Separate vent stacks shall also be provided with proper cowls or ventilators. Vent flues shall be built the same size throughout the entire flue length with inside walls plumb, true and with smooth finish. Foul air chambers in the attic shall have a cubic capacity at least equal to the combined capacity of all vent stacks connected with such chamber. A positive updraft shall be maintained in all vent stacks by blast aspiration or exhaust. In gravity systems of ventilation with steam heat foul air vent stacks shall have a minimum of 27 sq. ft. of radiation in each stack for aspirating purposes.

Cloakrooms and Wardrobes: Where cloakrooms or

wardrobes are not separated from classrooms, or are separated only by skeleton doors, they shall be considered as part of the classroom, and the foul air vent may be placed in the cloakroom or wardrobes. Where cloakrooms or wardrobes are separated from classrooms, they shall be separately heated and ventilated the same as classrooms. Where suitable cloakrooms cannot be provided, sanitary lockers may be placed in the corridors or classrooms, provided that such lockers will not in any way become an obstruction to the free passageway of the corridor.

Ventilation in Vocational Rooms: Gas plates, gas stoves and burners used in domestic science or laboratory work shall be provided with suitable ventilating hoods connected with a vertical vent flue. This flue shall be separate from any other vent flue and a positive updraft shall be maintained by blast, aspiration or exhaust.

Temperature Regulation: Whenever practical, temperature regulation shall be used.

Whatever system of ventilation is used, the windows in all schoolrooms shall be opened whenever practical at recess periods and before the opening of the afternoon school session in order to thoroughly change the air of the rooms.

Basement Air: In every stairway leading from the first floor to the basement, there shall be a swinging door with spring hinges to prevent basement air from entering the classrooms and corridors above and as a protection against fire occurring in the basement.

* * * * *

Under "Toilets," the provisions are that "there shall be ventilating opening in the back of each individual water-closet bowl and each seat of the latrine of not less than 10

sq. in. free area, and each urinal stall shall have a ventilating opening in top or bottom or both of not less than 8 sq. in. free area. These toilet ventilating openings shall be connected to a vertical brick vent flue extending above the highest point of the roof. The up-draft in this flue shall be positive at all times, to be maintained by blast, aspiration or exhaust. If stack heater is used the cross sectional area of this toilet vent flue shall be not less than 360 sq. in. If aspiration by steam, this toilet vent flue shall have not less than 36 sq. ft. of radiation. If an exhaust fan is used, the cross-sectional area of this toilet vent flue shall be equal to the combined area of the toilet ventilating openings connected with such flue, with a minimum flue area of 144 sq. in."

Under "Humidity," the regulations are that "whenever practicable a system of air washing shall be installed in connection with plenum and gravity systems of ventilation in order that the air may be properly humidified before being introduced into the schoolroom. Where the air supply is direct to the schoolroom, through wall openings, each radiator shall be provided with a pan or receptacle to hold not less than one gallon, and so placed as to be constantly warmed and in plain view. Water shall be kept in such receptacle at all times when school is in session and the heating system is in use.

Jacketed heaters and floor furnaces shall be provided with a pan or receptacle to hold not less than three gallons, and so placed as to be constantly warmed and in plain view. Water shall be kept in such receptacles at all times when school is in session and the heater is in use.

Cleaning and Sweeping: Whenever practicable, vacuum cleaning equipment shall be installed in school buildings. Dry sweeping and dusting is prohibited, and no sweeping

shall be permitted in corridors, schoolrooms or stairways while school is in session. Floor oil, some form of dust-down or sawdust treated with oil should be used on floors before sweeping.

Directions for Management: Whenever a system of heating and ventilation is installed, the heating contractor shall furnish full and complete printed instructions for the proper management and care of such system to the superintendent, principal or teacher of the school, and shall in addition post a copy of such instructions in a prominent place in the boiler or furnace room for the instruction of the janitor.

Heating: The heating apparatus and appliances not otherwise provided for in these Rules must conform to the Rules and Regulations of the State Fire Marshal.

Architects shall furnish heating and ventilating contractors full and detailed plans of all parts of the building in any way connected with the installation of heating and ventilating apparatus.

The following rule was adopted by the State Board of Health, April 14, 1916, as appears in the minutes of the Board:—

Ordered: All plans and specifications for school buildings and public buildings of all kinds shall be submitted to the State Board of Health for inspection and approval as to sanitary features before such plans are finally adopted; and that when such plans are approved by the State Board of Health, such approval shall be evidenced by the seal of the State Board of Health attached thereto.

The regulations here given are based in part on "The Sanitary Schoolhouse Law" (H. 494. Approved March 14, 1913). This law states under "Heating and Ventilation":

Heating and Ventilation: All schoolhouses hereafter

constructed or remodeled, shall be supplied with heating and ventilating systems. Fresh air shall be taken from outside the building and properly diffused without draughts, through each schoolroom during the school session. Each schoolroom shall be supplied with foul air flues of ample size to withdraw the foul air therefrom at a minimum rate of 1,800 cu. ft. per hour for each 225 cu. ft. of said schoolroom space, regardless of outside atmospheric conditions; and heaters of all kinds shall be capable of maintaining a temperature of 70° F. in all schoolrooms, halls, office rooms, laboratories and manual training rooms, in all kinds of weather, and maintaining in each schoolroom a relative humidity of not less than forty per cent: *Provided*, That when artificial ventilation, by use of fan or blower, is adopted, the provision as to entrance of fresh air shall be from outside of the building.

It is hereby made lawful for any township trustee, board of school trustees and boards of school commissioners to establish and maintain open air schools, and when such open air schools are established the provisions of this act governing heating and ventilation shall not apply to such open air schoolrooms.

KANSAS

The fire-escape and theatre inspection law (Chapter 197, Law of 1911) contains the following provisions for the ventilation of theatres:

VENTILATION OF THEATRES AND PICTURE SHOWS

Sec. 4. It shall be unlawful for the owner, proprietor or lessee to operate any theatre, picture show or place of amusement in any structure, room or place in the state of Kansas which structure, room or place is capable of containing fifty or more persons unless the system of ventilation is capable of supplying at least thirty cubic feet of fresh air per minute for each person therein.

Ventilator Fans—Booths for Picture Machines—Electric Wiring.

Sec. 5. All such structures, rooms or places used for the purpose mentioned in section 4 of this act having less than 500 cu. ft. of air space for each person, and all rooms having less than 2,000 cu. ft. of air space for each person in which the outside window and door area used for ventilation is less than one-eighth of the floor area, shall be provided with a draught fan or other artificial means of ventilation installed so as to force the stagnant air outward from said structure, room or place. In the end of the room opposite said fan an inlet ventilator shall be provided of sufficient size to admit the required amount of fresh air as provided in section 4 of this act. All booths used for moving picture machines shall be made of galvanized sheet iron of not less than 20 B. W. gage,

or $\frac{1}{4}$ -in. hard asbestos board, securely riveted or bolted to angle-iron frame (of not less than $1 \times 1 \times \frac{1}{4}$ inch angle-iron, properly braced), or equivalent fire resisting material. A not less than 6-in. diameter ventilating pipe shall be used as an exhaust for the hot air generated in operating the machine. All electric wiring shall be in accordance with the National Electrical Code.

Failure to comply with the provisions of the act constitute a misdemeanor and a penalty is provided of \$10.00 per day for such failure.

RULES, REGULATIONS AND SUGGESTIONS

In order to assist the fire chiefs and fire marshals to secure a full compliance with the requirements of the law, the following rules and suggestions on the subject of ventilation are made by the Department of Building and Factory Inspection of Kansas:

Ventilation of Theatres and Picture Shows: In order to aid fire chiefs, fire marshals and others in determining the amount of ventilating space, or number and size of fans necessary to meet the requirement of Sections 4 and 5, Chapter 197, Laws of 1911, the following rules are suggested:

A. The natural ventilation by doors and windows. Under normal conditions and at normal temperature, the velocity of air travel is estimated to be from 30 to 60 ft. per minute where the exhaust equals the intake area.

B. The natural ventilation by ventilating flues or chimneys. Under normal conditions the velocity of air travel is estimated to be from 200 to 300 ft. per minute. The velocity of air travel through ventilators in ceilings will range about 100 to 150 ft. per minute.

C. *Small power fans* placed in windows or openings in walls give a forced velocity of air travel of from 800 to

900 ft. per minute where fans compare reasonably well with the size of the opening.

D. *The velocity* in number of feet of air travel per minute, multiplied by the number of square feet of area of the openings used for ventilation, will give the *volume of air in cubic feet* that will pass through the opening per minute.

E. *To determine the required amount of artificial ventilation.* Multiply the number of seating capacity by 30, and from this amount subtract the number of cubic feet of air obtained per minute from natural ventilation, as per Rules 1 and 2. The remainder will be the amount of air in cubic feet to be supplied by fans or otherwise.

F. Where windows, doors or other natural means of ventilation are relied upon to furnish the required amount of fresh air, the fire marshal should see that they are kept open for that purpose, and all windows and other openings used as "intake" should be provided with proper shields or "baffle-boards" to prevent direct drafts on occupants of room.

All modern authorities on ventilation agree that the inlet openings should be near the top of room, or at least 8 ft. above the floor, and the outlet openings should be at or near the floor level, and in the opposite end of the room from inlet openings. Where seats are at different levels, outlet vents should be divided and placed at similar levels. Where fans are used they should always be placed at outlet, to draw the foul air out of the room. Short-circuiting of air currents should be guarded against.

LOUISIANA

A law is in effect in Louisiana conferring certain powers upon the State Board of Health, and acting under this authority the board has issued the following rules and regulations regarding the sanitation of public buildings: (Sanitary Code of Louisiana, Sections 119-122).

Every public or government building in this State, and every railroad depot, office building, theatre, lecture hall, auditorium, hotel, restaurant, boarding house, hospital, and other places where numbers of people congregate, must be properly lighted and so ventilated that there shall be 300 cu. ft. of air per hour for each occupant, and rooms or halls where over 150 people congregate must be provided with an exhaust fan for the removal of the lung exhalations and respired carbon dioxide of the occupants.

Schools.—Plans and specifications for every schoolhouse hereafter erected in the State must be submitted to the Parish Superintendent of Schools, and to the State Superintendent of Education, and also to the Parish Health Officer, that it may be determined whether every hygienic or necessary provision is made, especially with reference to ventilation, light, and protection against fire.

Every schoolhouse, public or private, or other building used for school purposes, shall be ventilated in such manner as to afford 1,800 cu. ft. of air per hour for each adult, and a proportionate amount for each child, and shall contain not less than 200 cu. ft. of air space for each child to be taught therein. Windows and transoms shall be so constructed that windows may be lowered from the top

and transoms opened. Every schoolhouse must be lighted in such a manner as to minimize the eye strain. Each room must contain of actual surface of glass in the windows not less than one-seventh of the floor space.

MAINE

The only provision in Maine relating specifically to ventilation is contained in the "Abstract of the Health Laws of the State of Maine." This provision relates to school buildings and approval of plans and is Chapter 88 of the Laws of 1909. Section 2 of this act reads:

"Sec. 2. Where the plans and specifications prepared by the State superintendent are not used (the State superintendent prepares such plans and specifications for not to exceed four-room school buildings) all school superintending school committees of towns in which new schoolhouses are to be erected, shall make suitable provision for the heating, lighting and ventilating and hygienic conditions of such buildings, and all plans and specifications for any such proposed school building shall be submitted to and approved by the State superintendent of schools and the State board of health before the same shall be accepted by the superintending school committee of the town in which it is proposed to erect such building."

In connection with this law, the State superintendent of public schools writes, under date of February 16, 1914:

This department, with the State Board of Health, has not compiled requirements for approved school buildings in printed form. Briefly, however, the following minimum requirements in relation to heating and ventilation are made:

The dimensions of school rooms must be sufficient to provide 240 cu. ft. of air space per pupil. Plans for ventilating must show provisions for at least 2,000 cu. ft. of air for each pupil. Fresh air inlets and foul air

outlets must be large enough to provide in cross section measurement from 16 to 20 sq. in. per pupil.

"Direct radiation from stoves or steam coils is discouraged. For small, single-room school buildings, jacketed stoves are in nearly all cases required.

"I may add that our requirements are made sufficiently elastic to serve primarily the purpose of securing improvement of school building conditions. In many cases it is not possible to secure ideal conditions."

MASSACHUSETTS

A law was passed in Massachusetts (Acts of 1913, Chapter 655), which is entitled "An Act to Revise and Codify the Building Inspection Laws of the Commonwealth." This law, which went into effect Nov. 1, 1913, is enforced by the Building Inspection Department of the District Police and contains the provisions now in effect regarding the heating and ventilating of school and other buildings. The sections relating to these subjects are given herewith:

Sec. 15. No building which is designed to be used, in whole or in part, and no building in which alteration shall be made for the purpose of using it, or continuing its use, in whole or in part, as a public building, public or private institution, schoolhouse, church, theatre, special hall, public hall, miscellaneous hall, place of assemblage or place of public resort, or as a factory, workshop or mercantile or other establishment and to have accommodations for ten or more employees, and no building more than two stories in height designed to be used above the second story, in whole or in part, and no building more than two stories in height in which alteration shall be made for the purpose of using it, or continuing its use, in whole or in part, as an office building, dormitory, hotel, family hotel, apartment house, boarding house, lodging house or tenement house, and to have eight or more rooms above said story, shall be erected, and no alteration shall be made therein, until a copy of the plans and specifications thereof has been deposited with the supervisor of plans of the building inspection department of the dis-

strict police by the person causing its erection or alteration or by the architect thereof. Such plans and specifications shall include those for heating, ventilation and sanitation, as the supervisor of the plans may require.

* * * * *

Sec. 16. Whoever erects, constructs or makes alteration in a building, or an architect or other person who draws plans or specifications or superintends the erection, construction or alteration of a building, in violation of the provisions of this act, shall be punished by a fine of not less than fifty nor more than one thousand dollars.

Sec. 22. No wooden flue or air duct for heating or ventilating purposes shall be placed, or shall remain placed, in any building which is subject to the provisions of sections fifteen and twenty of this act, and no pipe for conveying hot air or steam in such building shall be placed, or shall remain placed, within one inch of any wooden work, unless protected to the satisfaction of the inspector by suitable guards or casings of incombustible material.

Sec. 24. (Theatres). * * * There shall be one or more ventilators near the center and above the highest part of the stage, equal in area to one tenth of that of the stage floor back of the fire-resisting curtain, and arranged so as to open automatically from heat, and by a cord or cords from the stage floor, as the inspector shall direct.

Sec. 29. Cities may by ordinance provide that the provisions of sections fifteen, sixteen, twenty to twenty-eight, inclusive, forty-five and forty-six of this act shall apply to any building of three or more stories in height within their respective limits.

Sec. 30. In this act, the term "theatre" shall mean a building or part of a building in which it is designed to make a business of the presentation of dramatic, operatic

or other performances or shows for the entertainment of spectators, which is capable of seating more than four hundred persons, and which has a stage for such performances that can be used for scenery and other stage appliances. The term "special hall" shall mean a building or part of a building containing an audience or assembly hall capable of seating more than four hundred persons, which may be used for the occasional presentation of dramatic, operatic or other performances for the entertainment of spectators, with the use of scenery, under such conditions as the licensing officer shall direct, and for public gatherings. The term "public hall" shall mean any building, or part of a building, excluding theatres, armories, churches and schools, containing an audience or assembly hall capable of seating more than four hundred persons, and used for public gatherings, and for such entertainments, not requiring the use of scenery and other stage appliances, as the licensing officer may approve.

Sec. 40. Every public building and every schoolhouse shall be kept clean and free from effluvia arising from any drain, privy or nuisance, shall be provided with a sufficient number of proper water-closets, or privies, and shall be ventilated in such a manner that the air shall not become so impure as to be injurious to health. If it appears to an inspector that further or different heating, ventilating or sanitary provisions are required in any public building or schoolhouse, in order to conform to the requirements of this section, and that such requirement can be provided without unreasonable expense, he may issue a written order to the proper person or authority, directing such heating, ventilating or sanitary provisions to be provided. A school committee, public officer, or person who has charge of, owns, or leases any such public building or schoolhouse, who neglects for four weeks to com-

ply with the order of such inspector shall be punished by a fine of not more than one hundred dollars. * * *

(Provision is made in the law for an appeal from the decision of an inspector. If anyone is dissatisfied with any ruling made by an inspector or by the department, an appeal can be taken to the courts. In such an event the judge shall appoint three experts in the line of work from which the complaint is made. The loser by the court's decision pays the costs.)

Sec. 41. In the preceding section, "public building" shall mean any building or part thereof used as a public or private institution, church, theatre, special hall, public hall, miscellaneous hall, place of assemblage or place of public resort, and "schoolhouse" shall mean any building or part thereof in which public or private instruction is given to more than ten pupils at one time.

Sec. 52.. Sections fifteen, sixteen, twenty to twenty-nine, inclusive, forty-three, forty-four, forty-seven, forty-eight, fifty and fifty-seven of this act shall not apply to the city of Boston.

Sec. 54. The provisions of this act shall be enforced by the chief of the district police, and the chief of the district police shall issue such regulations as may be deemed necessary for the uniform enforcement thereof.

Acting under the authority of this act the district police have caused the following order to be issued, which succeeds "Form No. 83," which was for many years the guiding rule for the heating and ventilation of school buildings:

REQUIREMENTS OF FORM NO. 83A, INSPECTION DEPARTMENT,
MASSACHUSETTS DISTRICT POLICE

In the ventilation of school buildings the many hundred examinations made by the inspectors of this department

have shown that the following requirements can be easily complied with:

1. That the apparatus will, with proper management, heat all rooms, including the corridors, to 70° F. in any weather.

2. That, with the rooms at 70° and a difference of not less than 40° between the temperature of the outside air and that of the air entering the room at warm air inlet, the apparatus will supply at least 30 cu. ft. of air per minute for each scholar accommodated in the room.

3. That such supply of air will so circulate in the rooms that no uncomfortable draught will be felt, and that the difference in temperature between any two points on the breathing plane in the occupied portion of the room will not exceed 3°.

4. That vitiated air in amount equal to the supply from the inlets will be removed through the vent ducts.

5. That the sanitary appliances will be so ventilated that no odors therefrom will be perceived in any portion of the building.

To secure the approval of this department of plans showing methods or systems of heating and ventilation, the above requirements must be guaranteed in the specifications accompanying the plans.

Form B, as it is known, was issued by the Massachusetts District Police and contains additional regulations for the erection, alteration and inspection of schoolhouses in Massachusetts, based upon the law which went into effect November 1, 1913, entitled, "An Act to Revise and Codify the Building Inspection Laws of the Commonwealth."

Form B relates to graded or high school buildings of medium size, and takes in both public and private schools, academies, seminaries or colleges, containing one or more

rooms, where a regular course of instruction is afforded to more than ten pupils at one time.

Under "Boiler, Fuel, Storage and Work Rooms," it is specified that "in buildings hereafter erected, and in existing buildings if so directed, no boiler, fuel, storage or work rooms shall be placed under a corridor, stairway or egress, and wherever located, if so directed, they shall be enclosed in masonry or fireproof walls with fireproof ceilings, and all openings in the walls to the basement shall be provided with self-closing fireproof or automatic fire doors.

The heating and ventilation requirements are as follows:

For a mechanical system with the temperature of the outside air at zero, or for a gravity system with the rooms at 70° F. and with the temperature of the outside air not less than 40° F. below that of the air entering the rooms through the inlets necessary to maintain 70° F. in the rooms, the apparatus shall insure the removal near the floor levels, through ventiducts by the aid of heat or its equivalent, with approved regulating dampers, of not less than 30 cu. ft. of air per minute for each person accommodated in the class, recitation, domestic science and manual training rooms and laboratories, and of not less than 2½ cu. ft. of air per minute for each foot in area of the assembly hall and gymnasium floors.

Such apparatus shall also have means to supply, through properly located inlets, pure air equal to the amount removed, and at such height from the floors as to insure proper circulation, with means for the proper heating of such air when necessary, and with approved regulating, protecting and mixing dampers or other approved methods for regulating the temperature, so that no uncomfortable draughts will be felt and that the difference in temperature between any two points on the breathing plane, not less than 2 ft. from an outside wall, will not exceed 3° F.;

and it shall have sufficient means for heating as to maintain a temperature throughout such rooms of 70° F. in zero weather.

The velocity of the air entering the ventiducts in the class, recitation, domestic science and manual training rooms and laboratories shall not exceed 400 ft., in the assembly hall and gymnasium shall not exceed 500 ft., and through the grilles of the inlets shall not exceed 350 ft. per minute. The offices, teachers' and emergency rooms, corridors and wardrobes shall have approved ventilation, and shall be provided with sufficient heat for their respective uses. The first-story corridors shall have an approved number and class of foot-warmers, where applicable.

Direct radiation may be installed in the class, recitation, domestic science and manual training rooms and laboratories, assembly hall and gymnasium only in such amounts as to heat the rooms to a temperature of 60° F., and in recreation, sanitary and toilet rooms to at least 70° F., in zero weather.

Provisions may be made for reversing any of the above circulation for use when heat is not required, or for an indirect heating system having a plenum or supply chamber below the floor, delivering an approved amount of air to the rooms through perforated chair or desk standards, or their equivalent, and exhausting the same through grilles in the center and near each corner of the ceiling, with approved means for regulating the circulation of the air and temperature of the rooms.

A hood of such size as to carry off all odors, fumes and gases, shall be placed over each stove in the domestic science room and over each demonstration table and compartment in the chemical laboratory and chemical laboratory lecture room. These hoods shall be connected by approved size ducts with ventiducts independent of those

for the room ventilation, or, if the combined area of the hood ducts in a room is sufficient, and so arranged, no other exhaust from the room will be required.

All fresh air rooms, heating chambers and heating and ventilating ducts or flues shall be of masonry, or metal of suitable gauge, thoroughly stayed and secured in place. All wall-inlet grilles shall be not less than 1 ft. more in height than the depth of the flue. Steam, hot water, electricity, furnaces or jacketed stoves may be used for heating. Provision shall be made, if so directed, for the installation of a primary heating and air washing apparatus.

The following regulations are published as Form F and cover "the erection, alteration and inspection of miscellaneous halls." A miscellaneous hall is defined as a building or part of a building used as a hall for entertainment, a place of assemblage or a place of public resort, and having a capacity for seating not more than 400 persons, also a hall for society use or a school hall, to each of which a certificate has been issued by an inspector.

Definitions are also given for halls of entertainment, halls for places of assemblage, halls for places of public resort and halls for society use.

Under "Heating and Ventilation" the regulations state: "The audience hall shall have such means as to insure the removal near the floor levels, through ventiducts with approved regulating dampers, of at least $2\frac{1}{2}$ cu. ft. of air per minute for each foot in area of the audience hall and gallery floors, and to supply pure air equal in amount at such height from the floor as to insure proper circulation, with means for the proper heating of such air when necessary, with approval methods for regulating the temperature, and sufficient means for heating as to maintain a temperature throughout the audience hall of 70 degrees F. in zero weather. The velocity of the air entering the venti-

ducts shall not exceed 500 feet, and of the air entering the audience hall shall not exceed 350 feet, per minute. Provisions may be made for reversing the above circulation for use when heat is not required. The stage, corridors and other parts of the building shall be properly heated when necessary."

Practically the same phraseology is used in Form D, relating specifically to "special and public halls," and in Form D, relating specifically to "theatres."

In this connection it should be noted that building plans throughout the Commonwealth are now passed upon by a supervisor of plans and he will not approve any that do not provide for ventilation from near the floor level.

MICHIGAN

Detroit

A city ordinance on ventilation, passed in Detroit in 1881 and apparently long forgotten, was brought forward by a number of public-spirited citizens in Detroit to secure better air conditions in the factories and similar places in that city. The full text of the ordinance is as follows:

Chapter 125, Detroit City Ordinance. (Approved September 7, 1881.)

Section 1. No person, persons, company or corporation shall employ, put or keep at work in any room, building or enclosure in the city of Detroit a greater number of persons than shall be warranted by the laws of health or approved by the board of health of said city. Every manufactory, workshop, salesroom, warehouse and other place of like character where two or more persons are employed shall have suitable ventilating appliances, sufficient for the carrying off of all foul or impure air, and for the reduction of the air therein to the standard of fresh air, and every place shall have therein in each and every work room at least five hundred cubic feet of air space for every person therein employed.

Sec. 6. The board of health shall visit and inspect, or cause to be visited and inspected, by the health officer, all places in the city used or occupied for the purposes above mentioned, at least once in every two months, to see that the requirements of this ordinance are complied with and for the purpose of making complaint for any violation thereof.

Sec. 9. Any corporation, manufacturer, employer, agent or other person refusing admission to his or her factory, workshop, store or other place of employment or service to the board of health or health officer, or refusing or neglecting to comply with the provisions of this ordinance, shall be fined not exceeding two hundred dollars; and in the imposition thereof the court may further sentence that, in default of the payment of the fine imposed, the offender be imprisoned in the Detroit House of Correction for any period of time not exceeding six months.

MINNESOTA

STATUTORY PROVISIONS

Among the powers and duties of the superintendent of education, the following are enumerated in Section 6, Chapter 550, Laws of 1913:

"He shall prescribe rules and examine all plans and specifications for the erection, enlargement and change of school buildings, which plans and specifications shall first be submitted to him for approval before contract is let, and no new school building shall be erected or any building enlarged or changed until the plans and specifications have been submitted to and have been approved by the superintendent of education. He shall include in such rules those made from time to time by the State Board of Health, relative to sanitary standards for toilets, water supply and disposal of sewage in public school buildings. In all other respects the authority to make rules for public school buildings shall be vested in the superintendent of education. Under such rules and procedure as the superintendent or the high school board shall prescribe, he may condemn school buildings and sites which are unfit or unsafe for use as such."

Rules of the Minnesota Department of Education

HEATING AND VENTILATION

Sec. 40. *Capacity of Plants:*

1. All heating plants, including both direct and indirect radiation, must be of sufficient capacity to maintain a uniform temperature of 70° F. at the breathing plane in

all schoolrooms when the outside temperature does not fall below 20° F. Standard temperature of all schoolrooms shall be not more than 68° F. nor less than 65° F. In corridors and coat rooms the temperature shall be maintained at not less than 60° F.

2. A system of ventilation shall furnish not less than 30 cu. ft. of air per minute for each person that the room will accommodate in accordance with the rules governing seating capacities of rooms. The capacity of a gravity system of ventilation shall be subject to test in accordance with this provision only when the difference of temperature of the outside air and the air of the schoolrooms shall be 40° F., or more. Ventilation systems in connection with ventilating room heaters shall be subject only to the provisions hereinafter stated in section 49-57. Study rooms not occupied continuously to their full capacity shall be subject to such modifications as may be approved by the Commissioner of School Buildings, but in no case shall a system be approved which does not renew the air at least four times per hour. Assembly rooms must in all cases be provided with mechanical systems of ventilation which will renew the air at least four times per hour.

Sec. 41. *Direct-Indirect Ventilation:* The direct-indirect system of ventilation must not be installed in any schoolroom. By "direct-indirect" is meant that the introduction of cold air from outside the building at the base or upon any part of a "direct" radiator.

Sec. 42. *Rotation of Air:* Return ducts providing for reheating schoolroom air are prohibited, unless the air is passed through an air washer of approved design. Provision in such case must be made for the introduction of at least 25% per cent of outside air to be mixed with the washed air.

Sec. 43. *Ventilation of Coat Rooms:* Ventiducts must be installed in all coat rooms adjoining schoolrooms. Schoolroom air may be wholly or partly vented through coat room. Coat rooms separated from schoolrooms must be equipped with heat and vent ducts in the same manner and according to the same rules as schoolrooms, or ventilated by means of an exhaust system, on a basis of complete change of air not less than once every ten minutes.

Sec. 44. *Ventilation of Laboratories, Domestic Science Rooms and Toilets:* Ventiducts from hoods in chemical laboratories, from domestic science rooms and from toilet rooms, shall extend independently through the roof of the building. Each duct shall be equipped with an aspirating coil, or an exhaust fan.

Sec. 45. *Ventiducts:* All ventiducts must be continuous throughout their entire length, and must lead directly through roof, or to ventilator if several flues are combined.

Sec. 46. *Registers:* All registers shall have an area of not less than 125% of the cross section area of the flue. In schoolrooms heat registers shall be placed about 8 ft. above the floor. Vent openings may be without registers.

Sec. 47. *Floor Registers:* Floor registers may not be installed in any school building, but heat registers in coat rooms may be placed 8 in. above floor.

Sec. 48. *Foot Warmers:* So-called foot warmers are not recommended, but if installed no register shall be placed in the floor. Registers will be permitted in the walls with edge at floor levels, or on sides of seats.

VENTILATING ROOM HEATERS

Sec. 49. *Capacity of:* No room heater shall be deemed adequate unless it shall form to the following standards:

1. For rooms of 6,000 cu. ft. or less, the grate area shall be not less than 180 sq. in.

2. For rooms of 6,000 to 8,000 cu. ft., the grate area shall be not less than 210 sq. in.

3. For rooms of 8,000 to 10,000 cu. ft., the grate area shall be not less than 240 sq. in.

Sec. 50. *Pattern of:* Ventilating room heaters must be of approved pattern of the upright type without rims or projections which will in any way interfere with the free circulation of air inside the shield.

Sec. 51. *Shield:* The shield must entirely surround the heater and no part thereof shall be less than 6 in. from the radiating surface of such heater. In no case shall the lower edge of the shield, be more than 14 in. nor less than 8 in. from the floor. It must, in every case, extend above the highest part of the radiating surface of the heater. It must be constructed in such a manner that no perceptible amount of heat may be radiated from it. Shields may not extend to the floor, and perforations or partial openings at the base of the shield will not be accepted in lieu of its elevation from the floor.

Sec. 52. *Fresh Air Intake:* The fresh air intake for all schoolrooms not exceeding 10,000 cu. ft. shall be not less than 175 sq. in. cross section area, and must be constructed to prevent the cold air from dropping down and spreading out over the floor. No intake pipe of this dimension shall exceed 6 ft in length. Longer pipes must have such increased area as may be specified by the Commissioner of School Buildings.

Sec. 53. *Foul Air Flue:* The foul air flue shall conform to either of the following standards:

1. Single flue for smoke and foul air: Where a single flue is used for both smoke and foul air, the inside dimensions of the flue shall be 16 x 16 in. clear on the in-

side throughout its entire length, and shall be provided with an approved mixing chamber in order to insure a maximum of ventilation from the waste products of combustion. This requirement shall apply to all rooms not exceeding 10,000 cu. ft. Larger rooms shall be subject to such special requirement as may be deemed necessary by the Commissioner of School Buildings.

2. Foul air flue with metal smoke stack in center: Whenever foul air flue has metal smoke stack inside such foul air flue shall be constructed of double brick wall and be not less than 20 x 20 in. inside measurement. For a room of 10,000 cu. ft. or less the metal stack shall be 8 in. in diameter and made of No. 16 gauge iron, and shall be placed in the center of the foul air flue.

Sec. 54. *Double-flue Chimney*: Double-flue chimneys, in which it is proposed to use one flue for smoke and the other for the discharge of foul air, will not be approved.

Sec. 55. *Location of Foul Air Flue*: The foul air flue shall, in all cases, be located in the same end of the room as the heater, and in no case shall the foul air flue be less than 4 ft. from the shield of the heater.

Sec. 56. *Register of Foul Air Flue*: The foul air flue shall be equipped with a damper or a register. The register shall be not less than 300 sq. in. Register must be installed at floor level, but no register may be placed in floor.

Sec. 57. *Evaporating Pan*: A suitable container for evaporating water shall be placed, preferably on the stove, but in every case inside the jacket.

BASEMENT FURNACES

Sec. 58. The heating capacity of furnaces shall be determined as follows:

1. 1 sq. ft. of grate area to every 2,500 cu. ft. of contents of schoolrooms to be heated.

2. 1 sq. ft. of grate area to every 3,500 cu. ft. of contents of other rooms to be heated.

3. Not less than 30 sq. ft. of direct heating surface to every square foot of grate area.

4. Furnaces with greater direct heating surface than 30 sq. ft. to 1 sq. ft. of grate area, or with special heat tubes for separate hot air leaders, shall be subject to such variations from the above requirements as shall be determined by the Commissioner of School Buildings.

Sec. 59. *Fresh Air Intakes:* All air to be heated shall be drawn from outside the building into the fresh air intake, except that air passed through an air washer of approved design may be drawn from the building. The fresh air intakes, when located below the main floor, shall have a cross section area equivalent to not less than 80% of the cross section area of all the warm air ducts. When fresh air is taken in above the roof, such intake must be not less than 25 ft. from toilet vents. Proper precaution must also be taken to have opening from side opposite chimney or toilet vents, and protected by means of screens or louvers.

Sec. 60. *Furnace Casing:* The air space between the furnace and the outside casing shall have at least 25% more cross-sectional area than the total area of all the hot air leaders taken from it.

Sec. 61. *Warm Air Ducts:* In a gravity system of ventilation, the flues for admitting warm air to any room on the first floor shall have a cross-section area of not less than 1 sq. ft. for every 160 sq. ft. of floor area in the schoolroom. The warm air ducts for the second floor shall have a cross-section area of $\frac{3}{4}$ sq. ft. for every 160 sq. ft. of floor area.

Sec. 62. *Ventiducts:* In a gravity system of ventilation, the ventiducts from any room on the first floor shall have a cross-section area of not less than $\frac{3}{4}$ sq. ft. for every 160 sq. ft. of floor area of the schoolroom. The ventiducts from the second floor shall have a cross-section area of 1 sq. ft. for every 160 sq. ft. of floor area of schoolroom. Vent openings must be at the floor level, on the same side of the room as the warm air flues. If desired, part or all of the air from the schoolroom may be vented through coat rooms immediately adjoining this side of the room. Satisfactory provision must be made for stimulating an upward current in ventiducts.

Sec. 63. *Dampers:* A ventiduct shall be provided with an approved damper, having an operating device in the room for which the ventiduct is used.

Sec. 64. *Plenum Fan Ventilation:* The warm air ducts and the ventiducts of a plenum fan system of ventilation shall have a horizontal area of not less than 1 sq. ft. for every 270 sq. ft. of floor area of the schoolroom.

Sec. 65. *Humidity of Air:* Vapor pans for moistening air must be installed with every furnace, and preferably placed inside of casing near the top.

STEAM HEAT AND GRAVITY VENTILATION

Sec. 66. *Installation:* The heating system shall be combined with the ventilation system, and whenever practicable, the direct radiation and the indirect radiation shall be connected to separate mains.

Sec. 67. *Areas of Ducts:* In a gravity system of ventilation, the heat ducts and the ventiducts shall each have a cross-section area of not less than 1 sq. ft. for every 160 sq. ft. of floor area of the schoolroom. Fresh air intake shall be as specified in Section 59.

Sec. 68. *Indirect Radiation:* Heat ducts shall be sup-

plied with not less than 50 sq. ft. of indirect radiation for each square foot of cross-section area of duct.

Sec. 69. *Accelerating Coil*: Each ventiduct shall have the equivalent of not less than 20 sq. ft. of accelerating coil.

MECHANICAL VENTILATION

Sec. 70. *Amount of Tempering Coil*: In a plenum fan system of ventilation, air being introduced into the room at approximately 70° F., the amount of tempering coil to be installed shall be computed on a basis of not less than 1 sq. ft. of actual heating surface for each 14 cu. ft. of air to be heated per minute.

Sec. 71. *Velocity Through Heater*: A velocity of not over 1,000 ft. per minute through the heater shall be used as a basis for computation.

Sec. 72. *Stacks of Tempering Coil*: Each stack of radiating coil must be valved separately. The installation must provide a free area which will permit a velocity of not more than 1,000 ft. per minute.

Sec. 73. *Size of Vertical Risers*: In a plenum fan system of ventilation, the size of all vertical risers—heat ducts and ventiducts—shall be computed on a basis allowing for a velocity of from 400 to 600 ft. per minute. Velocities in horizontal ducts shall be estimated on a basis of 900 to 1,000 ft. per minute.

Sec. 74. *Diffusers and Deflectors*: All fresh air outlets shall be equipped with a full set of diffusers and deflectors.

Sec. 75. *Velocity at Outlet*: The velocity of the air through the register face shall not exceed 300 ft. per minute.

Sec. 76. *Distribution of Heat Ducts*: When practicable, the fresh air to standard schoolrooms shall be

delivered through two ducts rather than concentrated through one. In high school assembly and study rooms, the number should be increased to such an extent that an even distribution of air is secured.

Sec. 77. *Fans*: All fans must be so designed, constructed, mounted and connected with motor that they will operate noiselessly and without vibration. Normal speed of fans shall be kept as low as possible, taking into full consideration the type of fan to be used, the resistance to be overcome, and the volume of air to be delivered. Specifications must state explicitly the type of fan, its outlet velocity, its capacity, and its normal speed.

MONTANA

"School Laws of the State of Montana," comprising all the laws in force and pertaining to public schools and State Educational institutions, contains the following, under "School House Sites" (Chapter XVI), compiled March, 1913:

1602. *Floor Space. Air. Light.*—The board of health shall not approve plans for the erection of any school building or addition thereto or remodeling thereof, unless the same shall provide, (a) at least 15 sq. ft. of floorspace and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein; (b) at least 30 cu. ft. of pure air per minute per pupil shall be furnished by a satisfactory ventilating system, which should also provide means for exhausting the foul or vitiating air from the room.

The light shall come from the left or from the left and rear of each schoolroom, and the window space shall be not less than one-seventh of the floor space of each room.

1603. *Penalties.*—The county treasurer shall not make any payments on any contract arising under the provisions of this chapter until the contractor furnishes a certified statement signed by the State board of health that the plans and specifications of the school building to be erected or remodeled, have been fully approved by the State board of health.

NEW JERSEY

The so-called "Stokes" law in New Jersey, passed in 1903, regulating the ventilation of school buildings has been repealed and a new law passed giving the State Board of Education the power to make rules and regulations with reference to the construction of school buildings. While the board's regulations are not published as statutes yet practically they are equivalent to statutes. Referring to the rules, the inspector of building writes:

"The reference to ventilation may appear somewhat ambiguous, with reference to the method of introducing fresh air into the classrooms, but the construction which we have placed upon the requirement with reference to fresh air is that the air shall be introduced positively, not relying on atmospheric conditions. We do, however, approve of certain ventilating stoves in the smallest of buildings, such as one and two rooms, one story in height."

The rules covering ventilation are as follows:

"Each classroom shall have at least 18 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in such classroom. All school buildings shall have a system of ventilation by means of which each classroom shall be supplied with fresh air at the rate of not less than 30 cu. ft. per minute per pupil. Approved ventilating stoves will be allowed in all one-story school buildings, and in all school buildings in which the number of rooms does not exceed two.

The State Board of Education strongly recommends the installation of a mechanical system of ventilation,

operating by electricity, gas, steam or other motive power, in all buildings of four or more rooms, and of two or more stories in height, as experience shows that gravity ventilation is unreliable.

Heat and Vent Flues. All fresh and foul air ventilating flues and ducts must be of fireproof material and the flues and ducts shall not come in contact with wood construction.

HEAT

The heating plant must be capable of heating all parts of the building to a uniform temperature of 70° F. in zero weather, with the ventilating system furnishing the required amount of fresh air in each classroom.

Heater Rooms. All boiler and furnace rooms shall be enclosed by fireproof walls, floors and ceilings, and all doors shall be of Underwriters' approved type firedoors, tin-clad, hung with proper equipment to keep them closed. The ceiling or floor construction over said rooms shall be of reinforced concrete or standard fireproof hollow arched tile and steel beam construction, designed to be absolutely fireproof and capable of sustaining a live load of 100 lbs. per square foot.

NEW YORK STATE

This law was passed by the Legislature of New York in 1904. (Chapter 281.)

An Act to amend the consolidated school law, relative to proper sanitation, ventilation and protection from fire of schoolhouses.

Sec. 517. No schoolhouse shall hereafter be erected in any city of the third class or in any incorporated village or school district of this State, and no addition to a school building in any such place shall hereafter be erected, the cost of which shall exceed \$500, until the plans and specifications for the same shall have been submitted to the commissioner of education and his approval endorsed thereon. Such plans and specifications shall show in detail the ventilation, heating and lighting of such buildings. Such commissioner of education shall not approve any plans for the erection of any school building or addition thereto unless the same shall provide at least 15 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by him unless provision is made therein for assuring at least 30 cu. ft. of pure air every minute per pupil, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting or other competent authority in any such city, village or school district, exceeding the sum of \$500, shall be levied by the trustees until the commissioner of education shall certify that the plans and specifications for the same comply with the

provisions of this act. All schoolhouses for which plans and detailed statements shall be filed and approved, as required by this act, shall have all halls, doors, stairways, seats, passageways and aisles and all lighting and heating appliances and apparatus arranged to facilitate egress in cases of fire or accident and to afford the requisite and proper accommodations for public protection in such cases. All exit doors shall open outwardly and shall, if double doors be used, be fastened with movable bolts operated simultaneously by one handle from the inner face of the door. No staircase shall be constructed with wider steps in lieu of a platform, but shall be constructed with straight runs, changes in direction being made by platforms. No doors shall open immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such doorway.

This act shall take effect immediately.

Note—It will be noted that as the law applies to cities of the third class, etc. (Par. 1) the non-inclusion of cities of the first and second class (New York and Buffalo) exempts them from the provisions of the law.

NORTH DAKOTA

A law passed in North Dakota March 6, 1911, governs "the construction of public school buildings and providing for the inspection, ventilation and sanitation thereof (Chapter 269, General School Laws.)

1. *Buildings inspected. Plans and specifications to be submitted to superintendent of public instruction.* No building which is designed to be used, in whole or in part, as a public school building, shall be erected until a copy of the plans thereof has been submitted to the state superintendent of public instruction, who for the purposes of carrying out the provisions of this act is hereby designated as inspector of said public school building plans and specifications, by the person causing its erection or by the architect thereof; such plans shall include the method of ventilation provided for, and a copy of the specifications therefor.

2. *Construction of school houses.* Such plans and specifications shall show in detail the ventilation, heating and lighting of such building. The state superintendent of public instruction shall not approve any plans for the erection of any school building or addition thereto unless the same shall provide at least 12 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein.

(1) Light shall be admitted from the left or from the left and rear of classrooms and the total light area must, unless strengthened by the use of reflecting lenses be equal to at least 20 per cent of the floor space.

(2) All ceilings shall be at least 12 ft. in height.

(3) No such plans shall be approved by him unless provision is made therein for assuring at least 30 cu. ft. of pure air every minute per pupil and warmed to maintain an average temperature of 70° F. during the coldest winter weather, and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting or other competent authority in any such city, village, or school district, exceeding the sum of \$2,000.00 shall be levied by the trustees until the state superintendent of public instruction shall certify that the plans and specifications for the same comply with the provisions of this act.

* * * * *

4. *Method of Inspection and Adjustment of Grievances.*
—If it appears to the state superintendent of public instruction or his deputy appointed for that particular purpose, that further or different sanitary or ventilating provisions, which can be provided without unreasonable expense, are required in any public school building, he may issue a written order to the proper person or authority, directing such sanitary or ventilating provisions to be provided. A school committee, public officer or person who has charge of any such public school building, who neglects for four weeks to comply with the order of said state superintendent of public instruction or his deputy, shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars.

(1) Whoever is aggrieved by the order of the state superintendent of public instruction or his deputy issued as above provided, and relating to a public school building, may within thirty days after the service thereof, apply in writing to the board of health of the city, town, incor-

porated village or school district to set aside or amend the order; and thereupon the board, after notice to all parties interested, shall give a hearing upon such order, and may alter, annul or affirm it.

5. *Ventilating flues and method of constructing same.*—No wooden flue or air duct for heating or ventilating purposes shall be placed in any building which is subject to the provisions of this act, and no pipe for conveying hot air or steam in such building shall be placed or remain within one inch of any wood-work, unless protected by suitable guards or casings of incombustible material.

6. *Approval of plans. By whom and penalty for violation.* To secure the approval of plans showing the method or systems of heating and ventilation as provided for in section 2 the foregoing requirements must be guaranteed in the specifications accompanying the plans. Hereafter erections or constructions of public school buildings by architect or other person who draws plans or specifications or superintends the erection of a public school building, in violation of the provisions of this act, shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars.

OHIO

The Ohio State Building Code is being enacted into law in sections. In its entirety it is designed to regulate the construction of, repair of, alterations on and additions to public and other buildings and parts thereof; also the sanitary condition of public and other buildings, etc. The complete code applies to opera houses, halls, theatres, churches, schoolhouses, academies, seminaries, infirmaries, sanitoriums, children's homes, hospitals, medical institutes, asylums, memorial buildings, armories, assembly halls or other buildings used for the assemblage or betterment of people in any municipal corporation, county or township in Ohio and refers to alterations as well as new work.

PORTIONS OF CODE NOW IN FORCE

The portions of the code already passed by the Legislature are:

Part 1. Administration.

Part 2. (Title 1.) Theatres and Assembly Halls.

Part 2. (Title 3.) School Buildings.

Part 2. (Title 7.) Workshops, Factories and Public Buildings.

Part 1 contains the act providing for the administration of the code. In section 1 it is stated that "it shall be the duty of the chief inspector of workshops and factories or building inspector, or commissioner of buildings in municipalities having building departments to enforce all the provisions herein contained for the construction, arrangement and erection of all public buildings or parts

thereof, including the sanitary condition of the same, in relation to the heating and ventilation thereof."

In Section 5 it is stated that "nothing herein contained shall be construed to limit the control of municipalities from making further and additional regulations not in conflict with any of the provisions of this act contained nor shall the provisions of this act be construed to modify or repeal any portions of any building code adopted by a municipal corporation and now in force which are not in direct conflict with the provisions of this act."

Section 6 states that "the provisions of this act shall not apply to the construction or erection of any public buildings or to any addition thereto or alteration thereof, the plans and specifications of which have been heretofore submitted to and approved by the chief inspector of workshops and factories. The provisions of this act shall not apply to the construction, erection or equipment of any public building, addition thereto or alteration thereof, the contract for the construction, erection or equipping of which has been let or entered into prior to the date at which this act takes effect."

Failure to comply with the act constitutes a misdemeanor and is punishable by a fine up to \$1,000.

As already stated, the special requirements for the design, construction and equipment of the buildings referred to are contained in Part 2. The buildings are classified as follows:

Title 1. Theatres and assembly halls.

Title 2. Churches.

Title 3. School buildings.

Title 4. Asylums, hospitals and homes.

Title 5. Hotels, lodging houses, apartments and tenement houses.

Title 6. Club and lodge buildings.

Title 7. Workshops, factories and mercantile establishments.

Buildings or parts of buildings used only for the specific purposes mentioned under their respective title and classification shall be designed, constructed and equipped as called for under such title and classification. Buildings used for two or more different kinds of occupancy and combining the classifications covered under two or more different titles shall be designed, constructed and equipped according to all of the various sections of the different titles affecting such buildings or parts of such buildings.

TITLE 1 (PART 2).—THEATRES AND ASSEMBLY HALLS

Under the classification "theatres" are included all buildings or parts of buildings in which persons congregate to witness spectacular, vaudeville, burlesque, dramatic or operatic performances, or other buildings or parts of buildings in which scenery is used, or in which motion pictures are thrown upon canvas, screens or wall.

Under the classification of "assembly halls" are included all buildings or parts of buildings in which persons are assembled for entertainment or amusement, including halls used for lodge rooms or dancing, and, all places where persons congregate to witness vaudeville, burlesque, dramatic or operatic performances, to hear speakers or lecturers, to listen to operas, concerts or musical entertainments in which no scenery is used and no motion pictures are thrown upon canvas, screens or walls, and seating or accommodating 100 or more persons.

* * * * *

Sec. 8. *Heater Room.* Furnaces, hot water heating boilers and low pressure steam boilers may be located in the buildings, providing the heating apparatus, breeching,

fuel room and firing room are inclosed in a standard fire-proof heater room and all openings into the same are covered by standard self-closing fire doors.

No boiler or furnace shall be located under the auditorium, stage, lobby, passageways, stairways, exits of a theatre; or, under any exit, passageway or lobby of an assembly hall. No cast iron boiler carrying more than 10 lbs. pressure or steel boiler carrying more than 35 lbs. pressure shall be located within the main walls of any theatre or assembly hall.

* * * * *

Sec. 30. *Heating and Ventilating*.—A heating system shall be installed which will uniformly heat all parts of the building to a temperature of 65° F. in zero weather.

All parlors, retiring, toilet and check rooms, and all assembly halls used in connection with and a necessary adjunct to a church, school building, lodge building, club house, hospital or hotel shall be heated by an indirect system combined with a system of ventilation which will change the air not less than six times per hour. All other assembly halls and theatre auditoriums shall be heated and ventilated by a system which will supply to each auditor not less than 1,200 cu. ft. of air per hour.

The system to be installed where a change of air is required shall be either a gravity or mechanical furnace system, gravity indirect steam or hot water, or a mechanical indirect steam or hot water system.

No stove or open grate shall be used in any theatre or assembly hall, except water heaters, furnaces and boilers.

No stove pipe shall be more than 5 ft. long, measuring horizontally, unless the same be enclosed in a standard fire-proof heater room, nor shall any stove pipe come closer to any combustible material or ceiling than 3 ft.

The fresh air supply shall be taken from outside the building and no vitiated air shall be reheated. The vitiated air shall be conducted through flues or ducts to and be discharged above the roof of the building.

No floor register for heating or ventilating shall be placed in any aisle or passageway.

No coil or radiator shall be placed in any aisle or passageway used as an exit, but said coils and radiators may be placed in recesses formed in the wall or partitions providing no part of the radiator or coil projects beyond the wall line.

TITLE 3. SCHOOL BUILDINGS

This applies to public and private schools, also libraries, museum and art galleries, and "all buildings or structures containing one or more rooms used for the assembling of persons for the purpose of acquiring knowledge, or for mental training."

The heating and ventilating of such "school buildings" is provided for in Section 21 as follows:

Sec. 21. *Heating and Ventilation*.—A heating system shall be installed which will uniformly heat all corridors, hallways, play rooms, toilet rooms, recreation rooms, assembly rooms, gymnasiums and manual training rooms to a uniform temperature of 65° F. in zero weather; and will uniformly heat all other parts of the building to 70° F. in zero weather. (Exceptions. Rooms with one or more open sides used for open air or outdoor treatment.)

The heating system shall be combined with a system of ventilation which will change the air in all parts of the building except the corridors, halls and storage closets not less than six times per hour.

The heating system to be installed where a change of air is required, shall be either standard ventilation stoves

(Part 3, Title 10), gravity or mechanical furnaces, gravity indirect steam or hot water, or a mechanical indirect steam or hot water system. Where wardrobes are not separated from the classroom they shall be considered as part of the classroom and the vent register shall be placed in the wardrobe. Where wardrobes are separated from the classrooms, they shall be separately heated and ventilated the same as the classrooms.

The bottoms of warm air registers shall be placed not less than 8 ft. above the floor line, except foot warmers which may be placed in the floors of the main corridors or lobbies.

Vent registers shall be placed not more than 2 in. above the floor line.

The fresh air supply shall be taken from the outside of the building and no vitiated air shall be reheated. The vitiated air shall be conducted through flues or ducts and be discharged above the roof of the building.

A hood shall be placed over each and every stove in the domestic science room, over each and every compartment desk or demonstration table in the chemical laboratories and chemical laboratory lecture rooms, of such a size as to receive and carry off all offensive odors, fumes and gases. These ducts shall be connected to vertical ventilating flues placed in the walls and shall be independent of the room ventilation as previously provided for.

Where electric current is available, electric exhaust fans shall be placed in the ducts of flues from the stove fixtures in domestic science rooms and chemical laboratories, and where electric current is not available, and a steam or hot water system is used, the main vertical flues from the above ducts shall be provided with accelerating coils of proper size to create sufficient draft to carry away all fumes and offensive odors.

Blowers in workshops and factories, including rooms for manual training are taken up in General Code, State of Ohio, Section No. 1027.

Section 5 referring to Heater Rooms, states that "furnaces, hot water heating boilers and low pressure steam boilers may be located in the buildings, providing the heating apparatus, breeching, fuel room and firing room are enclosed in a standard fireproof heater room, and all openings into the same are covered by standard self-closing fire doors.

"No boiler or furnace shall be located under any lobby, exit, stairway or corridor.

"No cast-iron boiler carrying more than 10 lbs. pressure or steel boiler carrying more than 35 lbs. pressure shall be located within the main walls of any school building."

REQUIREMENTS OF THE DEPARTMENT OF INSPECTION OF THE
INDUSTRIAL COMMISSION OF OHIO FOR THE HEATING
AND VENTILATION OF PUBLIC BUILDINGS,
HOSPITALS, ASYLUMS AND HOMES

A special publication issued by the Department of Inspection of the Ohio Industrial Commission summarizes the requirements in the various classes of buildings, in part, as follows:

It will be noted that the provisions for the heating and ventilating of churches, asylums, hospitals and homes, are not statutory, because these requirements were not passed upon by the legislature when the State Building Code was enacted into law.

However, these provisions are legal since this department is given authority by law to examine and pass upon plans and specifications for buildings of this class and it is, therefore, necessary that the department adopt a code of regulations for the guidance of architects and engineers

in preparing their plans and specifications, so that they may know what requirements will have to be met in order to secure the department's approval, which is required before building operations are commenced.

CLASSIFICATION

A. Theatres.

Includes all buildings containing a stage with movable scenery or a motion picture machine.

B. Assembly Hall.

Includes all Assembly Halls or rooms, except Churches and Theatres.

C. Churches.

Includes all buildings used for Christian worship or religious instruction.

D. School Buildings.

Includes all Public, Parochial and Private Schools, Colleges, Academies, Seminaries, Libraries, Museums and Art Galleries.

E. Asylums, Hospitals and Homes.

Includes all buildings used for the detention, refuge, protection, treatment or care of the abandoned, homeless, infirm, helpless, blind, deaf, diseased in body or mind, incorrigible youths and felons.

(This classification does not include Hotels, Tenement Houses or Private Residences.)

TEMPERATURE

A heating system shall be installed which will uniformly heat the various parts of the building to the following temperatures in zero weather.

Theatres and Assembly Halls.

All parts of the building, except storage rooms, to 65° F.

Churches.

Auditorium, social and assembly rooms, 65° F.

All other parts of the building, except storage rooms, to 70° F.

School Buildings.

Corridors, hallways, play rooms, toilets, assembly rooms, gymnasiums and manual training rooms, 65° F.

All other parts of the building to 70° F.

Hospitals, Asylums and Homes.

Operating rooms, 85° F.

All other parts of the building, except storage rooms, to 70° F.

CHANGE OF AIR

The heating system shall be combined with a system of ventilation which at normal temperature will change the air the following number of times or supply to each person the following number of cubic feet of air per hour:

Theatres.

Parlors, retiring, toilet and check rooms, 6 changes per hour.

Auditoriums, 1,200 cu. ft. of air per person per hour.

Assembly Halls.

When used in connection with a school building, lodge building, club house, hospital or hotel, six changes per hour; and in all other assembly halls, 1,200 cu. ft. of air per hour per person.

Churches.

Auditoriums, assembly rooms and social rooms six changes per hour.

School Buildings.

All parts of the building, except corridors, halls and storage rooms, six times per hour.

Under "Registers" are the following provisions:

(h) *Warm Air Registers in Schoolrooms—Location of.*—The lower edge of the warm air registers in schoolrooms shall be located not less than 8 ft. above the floor line, except where the height of story is insufficient; in these cases the registers shall be placed close to the ceiling.

(i) *Vent Registers in Schoolrooms—Location of.*—Vent registers in schoolrooms shall be placed with the lower edge of opening not more than 2 ins. above the floor.

Where hot air furnaces are installed, detailed provisions covering such installation are contained in Section 196-13 to 196-16. Additional sections provide for the proper construction and arrangement of hearths, laundry stoves, drying rooms, gas ranges, ranges for hotels, etc.; bake ovens, core and annealing ovens.

Section 196-24 provides for the protection of wood around heating apparatus. Wherever any heating apparatus in which fires are maintained are located in cellars, the top of such heating apparatus shall not be less than 18 ins. from any wood-work.

The construction of standard fireproof heater rooms is contained in Section 196-25.

The penalty for violations of the code is a fine to be not less than \$25 nor more than \$500.

(See also Ohio laws governing factory and building inspection, Page 132.)

Heating and Ventilating Sections of Cleveland's Building Code

In the building code of the city of Cleveland provision is made for the regulation of the ventilation and heating of school houses, tenements, theatres, department stores, the idea being to promote better conditions of hygiene in these buildings.

The code provides that halls, auditoriums, schoolrooms, theatres and other places of public assembly or entertainment shall have in continuous operation, while occupied, a system of ventilation that will provide at least 25 cu. ft. of outside air per minute for each person for whom seating accommodation is provided. Department stores shall have a mechanical system of ventilation that will provide the following numbers of complete air changes per hour: Basements used for retailing merchandise, locker rooms, rest rooms and other rooms that are required by ordinance to be ventilated, six changes of air per hour; ground floor, six changes per hour; floors above the first four changes per hour, unless natural ventilation is provided.

A mechanical system of exhaust ventilation is required for kitchens connected with restaurants that will exhaust the air six times per hour. However, if the restaurant and its kitchen are not separate, six changes per hour are required for both the restaurant and its kitchen. In factories in which there is less than 20 sq. ft. of floor space for each employee, a mechanical system of ventilation is required that will provide six changes of air per hour. If more than 20 sq. ft. of floor space is provided for each employee, a system of ventilation is required that will provide four changes of air per hour, unless natural ventilation is provided as required by the city ordinance. In hospitals, jails, asylums, homes for the aged, houses of

correction and detention, etc., where there are sleeping accommodations for more than ten persons, ventilation systems are required in dormitories, cell blocks, wards, public sitting rooms, toilet rooms, and in other rooms where the inmates congregate.

SYSTEM OF CHURCH VENTILATION

Churches with a seating capacity of over 300, or where the clere-story height is less than 15 ft. must have a mechanical system of ventilation providing six changes of air per hour. If the seating capacity is less than 300 or if the clere-story height is 15 ft. or more, a modified system of ventilation which shall meet the approval of the engineer shall be installed.

The amount of carbon dioxide in any new building in the foregoing classifications shall not be permitted to exceed ten parts per 10,000 parts of air. The amount of carbon dioxide in buildings erected prior to the enactment of the code shall not exceed 12 parts per 10,000 parts of air. If tests of ventilation show that the percentage of carbon dioxide in the air is greater than the maximum prescribed, the building inspector may require additional ventilation, even if the requirements of the code as to air changes have been complied with.

An exception to these standards of ventilation is made in the case of storage rooms and vaults or where manufacturing processes would be materially interfered with. However, the code provides that the air in such places shall not be permitted to become detrimental to health or safety.

No part of the fresh air supply is to be taken from the cellar or basement. No person shall be exposed to any direct draft from any air inlet. All poisonous and noxious gases and all dust which is of a character that is injurious

to health in manufacturing plants must be removed by mechanical ventilation or exhaust devices.

VENTILATION OF TOILET ROOMS

The code provides that the ventilation system for toilet rooms shall not be connected with any other ventilating system in the building, but shall be a complete system discharging above the roof. Compartments containing no more than four water closets and without sufficient outside windows must have a gravity or mechanical system of exhaust ventilation that will change the air six times per hour. Compartments with more than four water closets and having sufficient outside windows shall have a gravity or mechanical system of exhaust that will change the air six times per hour. In the latter case, if the outside windows are insufficient, a mechanical system must be used that will provide six changes per hour. Rooms containing latrines or urinals with local vents are to be ventilated through the fixtures, and when such ventilation does not provide six changes per hour, additional ventilation must be provided. Wire or cloth screens are required for filtering air in all fresh air openings unless some other approved method is provided.

No floor registers will be allowed in any aisle or passageway excepting in churches, and no register there shall be larger than 18 in. square. In theatres, churches, etc., at least one-fifth of the ventilated air shall be removed by registers located near the floor. No radiator or other heating device shall be supported on any supply or return piping construction to the same, but must be carried on the floor or on hangers fastened to the floor, wall or ceiling.

Warm air furnaces must be supplied with fresh air from outside the building through a duct having an area

of at least 60% of the area of all warm air pipes. This fresh air duct may have a by-pass connection to the vestibule or hall near an outer door, but no such connection shall be permitted for the use of air from the cellar. Floor furnaces are prohibited.

OREGON

While Oregon has no State law on the subject of heating and ventilation, the city of Portland has a provision in its building code which states:

Sec. 518. Every hall, auditorium or room of every building hereafter erected for or converted to use as a school house, factory, workshop, theatre or place of public assembly or entertainment, shall have in continuous operation while occupied a system of ventilation so contrived as to provide 25 cu. ft. per minute of outer air for each occupant, and for each light other than electric light.

Or when any room or space is so proportioned as not to allow each occupant, if children, 600 cu. ft., and if adults 1,000 cu. ft. of fresh air per hour, or less than three times such amounts, in sick rooms or hospitals, by natural means without exposure to improper air currents, then such rooms shall be ventilated by artificial means.

PENNSYLVANIA

Pennsylvania enacted a ventilation law in April, 1905, entitled an act for the purpose of governing the construction of public school buildings in order that the health, sight and comfort of all pupils may be properly protected. It reads as follows:

Whereas, it is of great importance to the people of this Commonwealth that public school buildings hereafter erected by any board of education, school trustees or school directors shall be properly heated, lighted and ventilated.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same, That, in order that due care may be exercised in the heating, lighting and ventilating of public school buildings hereafter erected, no schoolhouse shall be erected by any board of education or school district in this State, the cost of which shall exceed \$4,000.00, until the plans and specifications for the same shall show in detail the proper heating, lighting and ventilating of such building.

Sec. 2. Light shall be admitted from the left or from the left and rear of classrooms, and the total light area must, unless strengthened by the use of reflecting lenses, equal at least twenty-five per centum of floor space.

Sec. 3. Schoolhouses shall have in each classroom at least 15 sq. ft. of floor space and not less than 200 cu. ft. of air space per pupil, and shall provide for an approved system of indirect heating and ventilation, by means of

which each classroom shall be supplied with fresh air at the rate of not less than 30 cu. ft. per minute for each pupil and warmed to maintain an average temperature of 70° F. during the coldest weather.

Sec. 4. All acts or parts of acts inconsistent herewith are hereby repealed.

Philadelphia

Commenting on the practice adopted by the engineering department of the Board of Public Education of Philadelphia, J. D. Cassell, superintendent of heating plants for the board, writes, under date of September 19, 1914:.

"Since 1912 we have changed our method of plenum heating, from indirect stacks of radiators placed at the bottom of each heat flue, to direct radiators or coils placed under the windows or along the exposed surfaces of the rooms to be heated, proportioning this surface to compensate for the heat unit loss of the equivalent glass surface. The temperature of the rooms is controlled by automatically operating the valves of the radiators or coils.

"We have also discarded the former use of underground air ducts and adopted the overhead system of air ducts, and are now heating the fresh air, furnished for ventilating, to a temperature between 70° to 80° F."

TENNESSEE

During 1913 a law was enacted creating a department of workshop and factory inspection (Chapter 11). This law was revised in 1915 (Chapter 170, Acts of 1915).

Sec. 2 of the revised law states that "said deputies referred to herein (deputy factory inspectors of the Department of Workshop and Factory Inspection) shall have the power and authority to order such changes as may by them be considered necessary to accomplish the highest degree of health, safety, comfort and efficiency possible."

Sec. 5 reads, "Every factory, workshop, association, or other establishment in which five or more persons are employed shall be so ventilated while work is carried on therein that the air shall not become exhausted as to become injurious to the health of the persons employed therein, and shall also be so ventilated as to render harmless, as far as practicable, all gases, vapors, dust or other impurities generated in the course of the manufacturing process or handicraft carried on therein.

Sec. 6 reads, "in every factory, workshop, association, or other establishment where work or process is carried on by which dust, filaments, or injurious gases are produced or generated, that are liable to be inhaled by persons employed therein, the person, firm or corporation by whose authority the said work or process is carried on shall cause to be provided and used in said workshop, factory, association, or other establishment, exhaust fans, conveyors, receptacles, or blowers with pipes and hoods extending therefrom to each machine, contrivance or ap-

paratus by which dust, filaments, or injurious gases are produced or generated; or provide other mechanical means to be maintained for the purpose of carrying off or receiving such dust, filaments, devitalized air, or other impurities as may be detrimental to the health of those in, about, or in connection with such place as herein mentioned. Provided, that if natural ventilation sufficient to exclude the harmful element above enumerated be provided, the requirement of this Section shall have been complied with by such firm, corporation, association, or other establishment as herein mentioned. Said fans, blowers, pipes and hoods shall be properly fitted and adjusted and of power and dimensions sufficient to effectually prevent the dust, filaments, or injurious gases produced or generated by said machines, contrivances, or apparati from escaping into the atmosphere of the room or rooms of said factory, workshop, or other establishment where persons are employed.

Sec. 11 provides for penalties for failure to comply with the law, such penalties running from \$50.00 to \$100.

The detailed rules in effect for the installation and maintenance of exhaust ventilating apparatus, for removing dust, vapors, odors, etc., are accompanied by the statement that the department is prepared to furnish blue print specifications, to be modified, enlarged, or changed to meet the requirements of any particular plant or industry.

UTAH

An Act of 1907 by the Utah State Legislature, and which went into effect in 1909, contains the following in Chapter 32, Section 1823:

LAWS OF UTAH, 1909

Section 1. That Section 1823, Compiled Laws of Utah, 1907, be, and the same is amended to read as follows:

1823. *Plans of New Buildings to be Submitted to Commission.* When necessary for the welfare of the schools of the district, or to provide proper school privileges for the children therein, or whenever petitioned so to do by one-fourth of the resident taxpayers of the district, the board shall call a meeting of the qualified voters, as defined in Section 1811, at some convenient time and place fixed by the board, to vote upon the question of selection, purchase, exchange, or sale of a schoolhouse, or for payment of teachers' salaries, or for current expenses of maintaining schools. The chairman of the board, shall be chairman, and the clerk of the board secretary to such meeting.

In case either of these officers is not present, his place shall be filled by some one chosen by the voters present. Notice, stating the time, place and purpose of such meeting, shall be posted in three public places in the district by the clerk of the District Board at least 20 days prior to such meeting. If a majority of such voters present at such meeting shall by vote select a schoolhouse, site, or shall be in favor of the purchase, exchange, or sale of a designated schoolhouse site, or of the erection, removal,

or sale of a schoolhouse, as the case may be, the board shall locate, purchase, exchange or sell such site, or erect, remove or sell such schoolhouse, as the case may be, in accordance with such vote; provided, that it shall require a two-thirds vote to order the removal of a schoolhouse.

Provided that no schoolhouse shall hereafter be erected in any school district of this state not included in cities of the first and second class, and no addition to a school building in any such place the cost of which schoolhouse or addition thereto shall exceed \$1,000 shall hereafter be erected until the plans and specifications for the same shall have been submitted to a commission consisting of the State Superintendent of Public Instruction, the Secretary of the State Board of Health, and an architect to be appointed by the Governor, and their approval endorsed thereon. Such plans and specifications shall show in detail the ventilation, heating and lighting of such buildings. The commission herein provided shall not approve any plans for the erection of any school building or addition thereto unless the same shall provide at least 15 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by them unless provision is made therein for assuring at least 30 cu. ft. of pure air per minute for each pupil and the facilities for exhausting the foul or vitiated air therein shall be positive and independent of atmospheric changes. No tax voted by a district meeting or other competent authority in any such school district shall be levied by the trustees until the commission shall certify that the plans and specifications for the same comply with the provisions of this act. All schoolhouses for which plans and detailed statements shall be filed and approved, as required by this Act, shall have all halls, doors, stairways, seats, passageways, and

aisles, all lighting and heating appliance and apparatus arranged to facilitate egress in cases of fire or accident and to afford the requisite and proper accommodations for public protection in such cases.

No schoolhouse shall hereafter be built with the furnace or heating apparatus in the basement or immediately under such building.

VERMONT

Under date of January 1, 1916, the State Board of Health of Vermont issued a set of rules and regulations which include, among other things, requirements for heating and ventilating school buildings and also motion picture theatres. The board's authority is based on the following law in effect in Vermont:

Sec. 5412. The words "public buildings," as used in this chapter, shall mean churches, court houses, jails, municipal rooms, state and county institutions, railroad stations, school buildings, school and society halls, hotels and restaurants more than two stories high, all buildings more than two stories high used or rented for tenements, boarders or roomers, and places of amusement one story or more in height; also factories, mills, workshops or other buildings more than two stories high, in which persons are employed above the second story.

Sec. 5413. Said board shall take cognizance of the interests of life and health of the inhabitants of the State, * * * and, when requested, or when, in their opinion, it is necessary, shall advise with municipal officers in regard to drainage, water supply and sewerage of towns and villages, and in regard to the erection, construction, heating, ventilation and sanitary arrangements of public buildings. * * *

Sec. 5416. Said board shall, when necessary, issue to local boards of health its regulations as to the lighting, heating and ventilation of schoolhouses, and shall cause sanitary inspection to be made of churches, schoolhouses and places of public resort, and make such regulations

for the safety of persons attending the same as said board deems necessary. Public buildings now standing or hereafter erected shall conform to the regulations of said board in respect to sanitary conditions and fire escapes necessary for the public health and for the safety of individuals in such public buildings.

A person, corporation or committee intending to erect a public building shall submit plans thereof showing the method of heating, plumbing, ventilation and sanitary arrangements to said board, and procure its approval thereof, before erecting such building.

Sec. 5417. A person, corporation or committee which erects a public building without the approval and without complying with the regulations of the State board of health as provided for in the preceding section, shall be fined not more than five hundred dollars nor less than one hundred dollars, and shall make such building to conform to the regulations of said board before the same is used, otherwise such building shall be deemed a nuisance, and be put in proper condition by the local health officer under the direction of said board at the expense of the owner.

Sec. 5418. Said board may examine or cause to be examined a school building or an outhouse and condemn the same as unfit for occupation or use, and the building or outhouse so condemned by written notice served upon the chairman of the board of school directors or the person having such school in charge shall not be occupied or used until the same is repaired and the sanitary condition approved by the State board of health; provided that said board shall not issue any order, the compliance with which would necessitate the expenditure by a town in any one year for repairing or erecting school buildings of a sum in excess of twenty per cent of the grand list

of the town. A person who violates a provision of this section shall be fined not more than fifty dollars nor less than five dollars.

The following regulations are intended for architects, corporations, committees, or other persons intending to erect or repair public building:

GENERAL REGULATIONS

1. Plans and specifications for all new work, alterations or repairs on public buildings, including plans for plumbing, heating, ventilation and fire escapes, shall be submitted for approval to the State Board of Health, and copies of such plans and specifications, when approved, shall be filed with said board.

SPECIAL REGULATIONS FOR SCHOOLHOUSES

10. *Construction of Building.*—a. The size of the building shall be determined according to the maximum number of pupils to be accommodated, due allowance being made for future demands.

b. The floor area shall be at least 18 sq. ft. for each pupil.

c. The cubic air space shall be not less than 200 cu. ft. of space for each pupil.

d. The standard height of room shall be 12 ft., and nothing less than this shall be used except by special permission of the State Board of Health.

e. The windows shall be of sufficient size and so arranged as to give ample light to every part of the room. The glass area of the windows shall be not less than one-fifth of the floor area. The windows shall be carried as close to the ceiling as the casing will permit.

13. *Heating and Ventilation.*—a. The heating appa-

tus shall be of sufficient size to warm all rooms to 70° F. in any weather.

b. For ventilation, not less than 30 cu. ft. of pure air per minute for each pupil shall be supplied, and it shall be so introduced that there shall be no uncomfortable drafts.

c. The difference in temperature between any two points on the breathing plane shall not exceed 3°.

d. The ventilating flues shall be of sufficient size to readily introduce and remove the requisite amount of air into and from the room.

e. Inlets for fresh air shall be placed 8 ft. above the floor. Outlets for foul air shall be at or near the floor level. Inlet and outlet ducts shall be placed on the same side of the room. Outlet ducts shall be heated unless an adequate fan system is used.

f. Where other systems of heating cannot be provided, as in one-room rural schools, jacketed stoves, arranged with the approval of the State Board of Health, shall be required.

g. In all systems of heating, provision must be made for controlling the temperature to avoid overheating by the introduction of cold air through suitable mixing dampers.

h. In all systems of heating, provision must be made for introducing a proper amount of moisture into the atmosphere of the room.

RULES GOVERNING THE DESIGN AND OPERATION OF PICTURE
THEATRES AND HALLS WHERE MOTION PICTURES ARE
GIVEN, ISSUED UNDER AUTHORITY OF SECTIONS
5416 AND 5417 OF THE PUBLIC STATUTES

These regulations as adopted by the State Board of Health apply to all commercial picture-houses or

halls regularly used for the exhibition of motion pictures.

MINIMUM STANDARDS FOR SPACE AND VENTILATION

Floor Area. A minimum of 4 1/3 sq. ft. of floor area as a seating space per occupant, exclusive of aisles and public passage ways, shall be provided in the audience hall.

Cubic Space. A minimum of 80 cu. ft. of air space per seat shall be provided in the audience hall.

Quantity of Outdoor Air. A positive supply of outdoor air from an uncontaminated source shall be provided in the audience hall at all times while the show is open to the public, and the quantity of this supply of outdoor air shall be based on a minimum requirement of 15 cu. ft. per minute, per occupant.

Temperature. The temperature of the air in the audience hall shall at all times, while the show place is open to the public, be maintained throughout at the breathing line (persons being seated) within the range of 62° F. to 70° F. (except when the outside temperature is sufficiently high not to require the air supply for ventilation to be heated). The temperature distribution and diffusion of the supplied outdoor air shall be such as to maintain the temperature requirement without uncomfortable draughts.

Direct Heat Sources. Any good heat source which does not contaminate the air will be accepted to supplement the warmed outdoor air supply. Gas radiators are prohibited.

Machine Booth Ventilation. Enclosures or booths for the motion picture machines shall be provided with special exhaust ventilation, with a capacity to exhaust at all times not less than 60 cu. ft. of air per minute through a one-machine booth, not less than 90 cu. ft. of air per minute through a two-machine booth and not less than

120 cu. ft. of air per minute through a three-machine booth.

This requirement shall include a number of small metal screened openings (equipped with special dampers and automatic appliance with fusible link to automatically close tight in case of fire in booth) on the sides of the booth near the bottom of the same, aggregating 180 sq. in. for a one-machine booth, 210 sq. in. for a two-machine booth, and 240 sq. in. for a three-machine booth; and this booth exhaust ventilation shall also include a metal or other fire-proof flue extending from the top or side at top of booth and carried to proper place of discharge out of doors. The ventilation should be augmented by mechanical or other means, so as to exhaust at least the quantity of air herein stated. The size of this special fireproof vent flue shall not be less than 96 sq. in. clear area for a one-machine booth, not less than 120 sq. in. clear area for a two-machine booth, and not less than 144 sq. in. for a three-machine booth, and this special vent flue shall be provided with an adjustable damper operated from the booth and equipped with an automatic appliance and a fusible link to operate to automatically open the damper wide in case of fire in the booth. The machine booth ventilation shall be kept in operation at all times when the booth is in use.

VIRGINIA

An Act for the purpose of regulating the construction of public school buildings in order that the health, sight and comfort of all pupils may be properly protected. (Chapter 187). Approved March 11, 1908.

1. Be it enacted by the General Assembly of Virginia, that the State Board of Inspectors for Public School Buildings shall not approve any plans for the erection of any school building or room in addition thereto unless the same shall provide at least 15 sq. ft. of floor space and 200 cu. ft. of air space for each pupil to be accommodated in each study or recitation room therein, and no such plans shall be approved by said board unless provision is made therein for assuring at least 30 cu. ft. of pure air every minute per pupil, and the facilities for exhausting the foul and vitiated air therein shall be positive and independent of atmospheric changes. All ceilings shall be at least twelve feet in height.

Extract from Amendments and New Laws of the General Assembly of 1898.

**REGULATIONS OF THE NATIONAL BOARD
OF FIRE UNDERWRITERS FOR THE IN-
STALLATION OF BLOWER SYSTEM
FOR HEATING AND VENTI-
LATING, STOCK AND REF-
USE CONVEYING**

(Recommended by the National Fire Protection Association.)

The following requirements covering the installation of blower systems for heating and ventilating and for stock and refuse conveying, were originally set forth by the National Fire Protection Association and were adopted last year by the National Board of Fire Underwriters:

Blower systems, which are often an economic necessity, usually introduce an additional hazard contributing to the cause and spread of fire, particularly when used for conveying stock and refuse. It is impossible to eliminate the fire hazard from such systems, but reasonable safeguards can be provided to reduce it.

The general standards applicable to blower systems are sub-divided into two classes: (a) heating and ventilating systems and (b) stock and refuse conveying systems.

CLASS A. HEATING AND VENTILATING SYSTEMS

1. *Blowers* (the word blowers is used to include blowers and fans).

(a) Blowers shall be so located as to be accessible for repairing and lubricating.

(b) Casings to be strongly built and properly reinforced where necessary; joints shall be air-tight. Casings and runners shall be entirely non-combustible, and large enough not to require overspeeding. To prevent accidents, openings into casings shall be protected with substantial screens or their equivalent.

(c) Bearings and journals shall be constructed in accordance with the best modern machine design and so proportioned as to prevent overheating. The bearings shall be self-oiled and so designed as to prevent leakage of oil. They shall be located outside of casings or ducts wherever possible. If located inside of casings or ducts, oilless self-lubricating bearings shall be used, made of bronze bushings fitted with plugs, such as graphite or metaline.

2. *Ducts* (the word ducts is used to include ducts, flues, pipes and tubes).

(a) Openings through floors for the circulation of air from one story to another shall not be used.

(b) Entire system of ducts shall be self-contained; no rooms, hallways, attics, hollow spaces, voids, nor other portions of the building shall be used for air chambers or ducts, unless by fire-resisting construction, and then only by permission of the inspection department having jurisdiction.

(c) Ducts shall be made of galvanized iron or other approved non-combustible material. The same applies to enclosures of steam coils used for heating air.

(d) Shall be thoroughly braced.

(e) Shall be substantially supported by metal hangers, brackets, or their equivalent.

(f) Where subject to mechanical injury, ducts shall be properly protected.

(g) In no case shall the clearance between any metal

ducts and combustible material be less than 1 in. More than 1 in. is usually desirable.

(h) The passing of ducts through fire walls should be avoided wherever possible. Where ducts pass through fire walls they shall be provided with automatic dampers, or national standard vertical automatic fire doors, located on each side of the wall through which they pass. (See Fig. 1).

(i) All ducts passing through floors shall be made of or protected throughout by approved fire resisting ma-

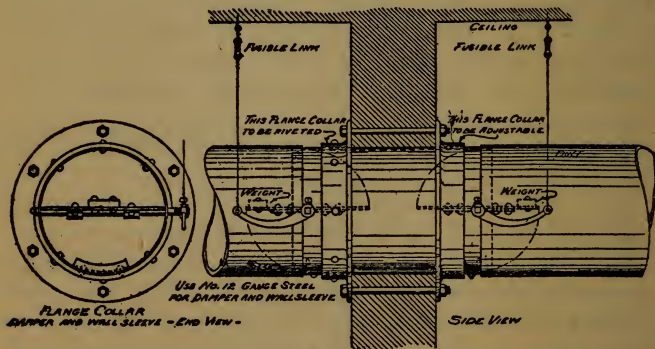


Fig. 1.

terials, such as 4-in. brick, hollow tile, or 2-in. cement plastered partition supported by a substantial steel frame.

(j) Where vertical ducts serve more than one floor, automatic dampers shall be provided on all outlet openings directly from such vertical ducts, and at all connections with branch ducts from such vertical ducts (See Figs. 2 and 3).

(k) Joints between ducts and floors, walls or partitions, must be made tight by non-combustible material.

(l) Outlets on supply and exhaust ducts should always

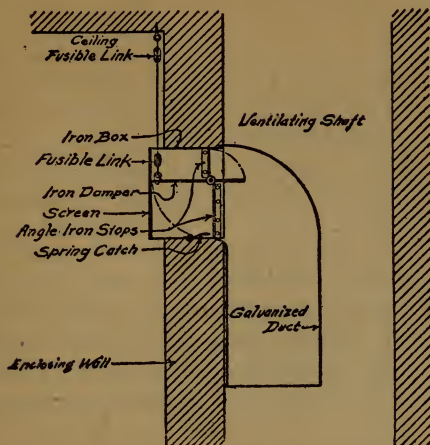


Fig. 2—Typical Automatic Damper.

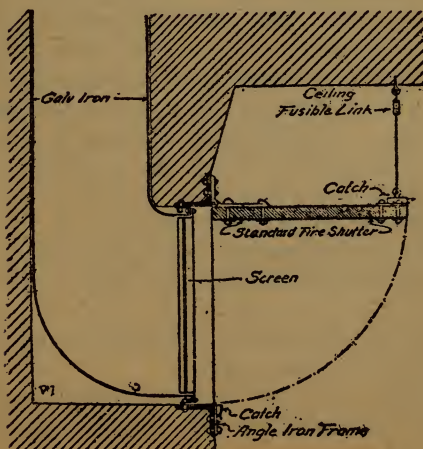


Fig. 3—Typical Automatic Shutter.

be protected by means of register faces or wire screens.

(m) Intake of air to be from outside except in recirculating systems, and shall be taken only from areas containing non-combustible material. Intakes must be protected with rolling shutters or heavy doors.

Intake and intake rooms, steam coils and blowers, etc., shall be segregated in a room cut off by fire-resisting partitions from other portions of the building.

(n) Blower system should preferably have an emergency or automatic control to shut them down in case of fire. This may be done automatically by means of devices utilizing fusible links, thermostats, or automatic sprinklers. Such installations to be subject to the approval of the inspection department having jurisdiction.

3. *Ventilation of Cooking Appliances.*

(a) Ventilating ducts used to carry off the grease-laden vapors from hoods over cooking appliances, especially in kitchens of large restaurants and hotels, shall be constructed similarly to boiler furnace flues (See Field Practice), and, if of metal, must be of not less than No. 16 U. S. gauge, so substantially built and well separated from all combustible material that a "flash" fire burning out the grease and gum on the interior of the duct will not endanger anything outside of it.

(b) The ventilating ducts shall be an independent system in no manner connected with other house ventilating systems.

(c) Ducts should not be connected to stacks, chimneys or flues used for other purposes.

(d) A live steam jet should preferably be provided at the end of the duct nearest the cooking appliances.

CLASS B. STOCK AND REFUSE CONVEYING SYSTEMS

The high velocity of the air and the inflammability of the stock or refuse which these systems are usually designed to handle make them especially hazardous.

The specific requirements of a ventilating system detailed under class "A" shall be applied to the stock and refuse conveying systems, also the following:

4. *Blowers.*

(a) Blowers shall be installed on proper foundations and secured in place in a manner subject to the approval of the inspection department having jurisdiction.

(b) Bearings of blowers shall not extend inside of blower casings or ducts.

(c) It is recommended that oilless self-lubricating bearings be used, made of bronze bushings with plugs such as graphite or metaline.

(d) Connections between discharge end of blower and main duct must be made so as to prevent leakage of fine dust.

(e) Blowers through which inflammable materials pass shall have blades of composition, copper or brass. Ample clearance shall be provided for all blades.

5. *Ducts.*

(a) Ducts for conveying stock and refuse shall be made of suitable non-combustible materials, preferably galvanized iron. All joints shall be riveted and soldered.

(b) Lock joints are acceptable for longitudinal seams in pipes used under suction. All such joints shall be made dust proof.

(c) Spiral pipes shall be riveted and soldered.

(d) Provision shall be made for the wear due to fric-

tion, at all points of change of direction, by making long bends, by using heavier metal, and in case where abrasive materials are to be conveyed, by inserting an approved form of inside lining that may readily be renewed.

(e) Suitable tight-fitting sliding clean-out doors shall be provided on all conveyor ducts at sufficient intervals to facilitate cleaning of ducts or removing obstructions.

(f) Suction ducts shall be provided at all machines producing dust or combustible refuse, and shall be connected to exhaust fans.

(g) "Sweep-up" pipes should be so protected as not to admit material which would be large enough to damage blower.

(h) Trunk line should be run on the outside wall of the building with ducts from each machine and each floor, passing out directly through the wall and discharging into the trunk line. If inside of building, the trunk duct shall be overhead rather than under the benches.

(i) The air vents from the system shall discharge outside of building.

(j) Where dust or readily inflammable material can accumulate on or near blowers and ducts, they shall be grounded to prevent ignition of these materials from a discharge of static electricity such as may be generated by a belt.

6. *Automatic Sprinklers.*

There shall be an approved sprinkler near the feed end, and at the discharge outlet, inside the condenser, if such is used, and also a sprinkler to protect the blower. In some cases, sprinklers may be installed inside the ducts. Such sprinklers should be arranged in an off-set or dome-shaped casing and not in the direct path of the draft. Sprinklers

with smooth deflectors that will not catch the flying stock are desirable.

7. *Cyclone Collectors or Separators.*

(a) The cyclones or separators shall be outside the building, and so located as not to constitute a hazard to adjacent structures. Their construction and supports shall be of incombustible material. If the cyclone of necessity is placed within 10 ft. of wooden walls, inflammable structures, or openings into buildings, it shall be provided with a metal pipe extending to a point above the main roof, or other safe location.

(b) The refuse from the cyclones and separators is to discharge by gravity into a vault as described in Section 9.

(c) If the discharge from the cyclone or separator conveys the refuse directly to the fire boxes of boilers, the feed spout shall have an open end discharging into a suitable receiver near the furnace, so that when the furnace gets choked the refuse will fall out on the boiler room floor giving the fireman a warning, also it would prevent "back fire" when the fan blowing the refuse is stopped.

(d) The air vent from the separator must not be connected to a chimney.

(e) If the air vent carries objectionable dust, as in the case of refuse, such as from grain elevators, etc., the use of a simple air washer, or other suitable filter, is recommended for eliminating the dust.

A screen shall be installed in the air vent to prevent sparks from entering.

8. *Special Cases.*

(a) Readily ignitable stock, such as cotton, should not pass through the fan. The system shall never be con-

nected directly to picker or other hazardous machines. Systems handling such stock shall operate entirely under suction with a device such as a "condenser," or large separating chamber to discharge the stock from the pipe or conduit before it reaches the fan. Stock should be fed to system preferably by hand. Stock shall enter such a system in an upward direction and the pipe shall continue upward for a least 10 ft. to allow any heavy substances or foreign material in the stock to drop out. If the pipe must leave the room at a lower level, a long radius inverted U may be used to obtain the necessary vertical distance.

(b) Systems using mixtures of cotton and wool which cannot be handled by condensers and which operate under fan pressure, shall discharge to non-combustible bins or boxes with outside vents through screens.

(c) Conditions which approach those favorable for explosive mixtures should be subject to a special investigation.

(d) The dust from sand-papery machines, granulators and pulverizers, buffing or polishing wheels, emery wheels and from other machines producing a very fine dust, shall have a suction system independent of the cyclone, which connects with the refuse vault.

The dust should be settled by spraying in an enclosed chamber of incombustible material, thus eliminating the hazard of the dust room. Dust from the machines may also be discharged directly into running water if suitable provision is made for its collection and removal.

(e) For mills, such as malt, cereals, sugar, celluloid, etc., it is recommended that an explosion flap be provided in a metal pipe leading outside of the building so that in case of an explosion in the mill the flap may open and the explosion spend itself outside the building.

9. *Vaults.*

(a) Vaults for shavings, refuse, etc., shall be located outside of building. Walls, floor and roof shall be of brick or other approved fire-resisting material.

(b) Openings, if any, between vault and boiler room should not exceed 9 sq. ft., and bottom of opening be not less than 6 in. above the level of boiler room floor. Openings shall be located at least 8 ft. from the firing door of boiler, preferably at right angles and protected by a standard automatic fire door.

(c) Roof of vault shall be provided with proper ventilating opening not less than 6 in. in diameter. As a protection from the weather this opening may be fitted with a suitable metal ventilator.

(d) Vaults shall be protected by approved automatic sprinklers. Where such protection is not available, steam jets may be installed for fire extinguishing purposes. (For details see "Field Practice.")

(e) Where dust-producing machines are used only on a small scale, the dust or refuse may, by special permission of the inspection department having jurisdiction, discharge into a substantial metal dust box, or other approved receptacle located outside the building, in lieu of a vault. The receptacle shall have a hinged door or cover, which will readily open and vent a fire or explosion within.

(f) A water tank may be used in lieu of the dust box. In such cases the tank should be provided with water supply, overflow and drain pipes. On the water supply pipe a proper float-controlled valve shall be installed to maintain a constant water level. It is recommended that the end of duct be submerged into the water at least one inch.

REQUIREMENTS FOR THE HEATING AND VENTILATION OF INDUSTRIAL BUILDINGS

Measures Taken in Thirteen States to Insure Suitable Working Conditions in Factories

While the factory inspection laws of all the States provide in a general way for healthful working conditions in factories, workshops and mercantile establishments, there are apparently but thirteen States that have definite regulations on the subject. These are New York, Massachusetts, Ohio, Illinois, Indiana, Iowa, Kansas, Pennsylvania, Michigan, Minnesota, New Jersey, Wisconsin and California.

CALIFORNIA

The factory ventilation law in California provides that "Every factory or workshop in which five or more persons are employed shall be so ventilated while work is carried on therein that the air shall not become so exhausted as to be injurious to the health of the persons employed therein, and shall also be so ventilated as to render harmless, as far as practicable, all the gases, vapors, dust, or other impurities generated in the course of the manufacturing process or handicraft carried on therein, that may be injurious to health."

The law also provides for the removal of dust, filaments or injurious gases by means of exhaust fans or blowers together with the usual system of pipes and hoods.

ILLINOIS

The Illinois law regarding the heating and ventilation of factory buildings is probably the most explicit of any so far enacted in this country. It is entitled, "An act to provide for the health, safety and comfort of employees in factories, mercantile establishments, mills and workshops in Illinois and to provide for the enforcement thereof." (Reenacted and approved June 29, 1915. In force July 1, 1915.)

Section 10 reads: "In every factory, mercantile establishment, mill or workshop, where one or more persons are employed, adequate measures shall be taken for securing and maintaining a reasonable and, as far as possible, equable temperature, consistent with the reasonable requirements of the manufacturing process. No unnecessary humidity which will jeopardize the health of employees shall be permitted."

The meat of the law is in Section 11 which reads: "In every room or apartment of any factory, mercantile establishment, mill or workshop, where one or more persons are employed, at least 500 cu. ft. of air space shall be provided for each and every person employed therein, and fresh air, to the amount specified in this act, shall be supplied in such a manner as not to create injurious drafts, nor cause the temperature of any such room or apartment to fall materially below the average temperature maintained: Provided, where lights are used which do not consume oxygen, 250 cu. ft. of air space shall be deemed sufficient. All rooms or apartments of any factory, mercantile establishment, mill or workshop, having at least 2,000 cu. ft. of

air space for each and every person employed in each room or apartment, and having outside windows and doors whose area, shall not be required to have artificial means of ventilation; but all such rooms or apartments shall be properly aired before beginning work for the day and during the meal hours. All such rooms, or apartments, having less than 2,000 cu. ft. of air space, but more than 500 cu. ft. of air space, for each and every person employed therein, and which have outside windows, and doors whose area is at least one-eighth of the floor area, shall be provided with artificial means of ventilation, which shall be in operation when the outside temperature requires the windows to be kept closed, and which shall supply during each working hour at least 1,500 cu. ft. of fresh air for each and every person employed therein. All such rooms or apartments, having less than 500 cu. ft. of air space for each and every person employed therein, all rooms or apartments having no outside windows or doors, and all rooms or apartments having less than 2,000 cu. ft. of air space for each and every person employed therein, and in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artificial means of ventilation, which will supply during each working hour throughout the year, at least, 1,800 cu. ft. of fresh air for each and every person employed therein: Provided, that the provisions of the preceding portions of this section shall not apply to storage rooms or vaults: And, provided, further, that the preceding portions of this section shall not apply to those rooms or apartments in which manufacturing processes are carried on which from their peculiar nature would be materially interfered with by the provisions of this section. No part of the fresh air supply required by this section shall be taken from any cellar or basement.

"The following terms of this section shall be interpreted to mean: the air space available for each person is the total interior volume of a room, expressed in cubic feet, without any deductions for machinery contained therein, divided by the average number of persons employed therein.

"Outside windows and doors are those connecting directly with the outside air; the window and door area is the total area of the windows and doors of all outside openings; and the floor area is the total floor area of each room."

"Sec. 12. All factories, mercantile establishments, mills or workshops shall be kept free from gas or effluvia arising from any sewer, drain, privy or other nuisance on the premises. All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the persons employed, which is created in the course of a manufacturing process, within such factory, mill or workshop, shall be removed, as far as practicable, by either ventilating or exhaust devices."

Sec. 20 covers the ventilation of toilet rooms to the effect that, "where practicable, they shall direct ventilation with the outside air; where it is impracticable (to so locate them), they shall be placed in an enclosure * * * and separately ventilated.

Sec. 25 * * * When general changes relative to the location and spacing of machinery or to ventilation have been made and such changes comply with the provisions of this act, such arrangements, conditions remaining the same, shall not be disturbed by any requirement of the chief state factory inspector or his deputies within the period of twelve months.

Fines for failure to comply with the foregoing provisions run from \$10.00 to \$50.00 for the first offense, and

from \$25.00 to \$200.00 for the second or subsequent offense.

Section 1 of the "Ice Cream Law" provides, "That all building or rooms occupied by butterine and ice cream manufacturers shall be drained and plumbed in a manner conducive to the proper and healthful sanitary condition thereof, and shall be constructed with air shafts, windows and ventilating pipes sufficient to insure ventilation. The Factory Inspector shall direct the proper drainage, plumbing and ventilation of such rooms or buildings."

PRACTICE OF THE ILLINOIS DEPARTMENT OF FACTORY INSPECTION

"We have no specific requirements as to heating, but you will note that Section 11 provides that artificial ventilation, when required, must be applied in a manner which will not cause injurious drafts or materially alter the temperature of the room."—OSCAR F. NELSON, Chief.

INDIANA

The Indiana Law on ventilation of industrial buildings states that "there shall be sufficient means of ventilation provided in each workroom of every manufacturing or mercantile establishment, laundry, renovating works, baker, or printing office within the state, and the chief inspector shall notify the owner in writing to provide or cause to be provided ample and proper means of ventilation for such workroom."

Owners or agents are to be prosecuted for non-compliance with the law within twenty days. The law also provides for exhaust fans for carrying off dust from emery wheels, grindstones and dust creating machinery, the size of mains, etc., being specified.

IOWA

In Iowa there is a law relating to exhausting systems for emery wheels or emery belts of any description, or tumbling barrels used for rumbling or polishing castings. "Any factory, workshop, print shop," the law adds, "or other place where molten metal or other material which gives off deleterious gases or fumes is kept or used, shall be equipped with pipes or flues so arranged as to give easy escape to such gases or fumes into the open air, or provided with other adequate ventilators."

KANSAS

Factory ventilation requirements in Kansas are contained in Secs. 10425 and 10426 of the General Statutes of 1915, and read as follows:

Sec. 10425—*Further powers.* The commissioner of labor and industry as State factory inspector, his deputies, assistants and special agents, shall have power to enter any factory or mill, work shop, private works or State institution having shops or factories, mercantile establishments, laundry or any other place of business where and when labor is being performed, when the same are open or in operation, for the purpose of gathering facts and statistics such as are contemplated by this act and to examine into the methods of protection from danger to employees and the sanitary conditions in and around such buildings and places and to keep a record thereof of such inspection. If it shall be found upon such investigation that the heating, lighting, ventilation or sanitary arrangement of any such establishment or place is such as to be injurious to the health of persons employed or residing therein, or that the means of egress in case of fire or other disaster are not sufficient, or that the belting, shafting, gearing, elevators, drums, saws, cogs or machinery, in any such establishment or place are so located, or are in a condition so as to be dangerous, or are not sufficiently guarded, or that the vats, pans or any other structures filled with molten metal or hot liquid are not surrounded with proper safeguards for preventing accidents or injury to those employed at, or near them, or that the construction or condition of any building or buildings, or any boiler, machin-

ery or other appurtenance in or about any place as described in this section is such as to be dangerous or injurious to the persons employed or residing therein, or that the methods of operation are such as to be unnecessarily dangerous or injurious to the persons employed or residing therein, or that any other condition which is within the control of the owner, proprietor, agent or lessee of any such building, establishment or place be found to be dangerous or injurious to any persons employed therein or to any other person or persons, the officer making such inspection shall notify in writing the owner, proprietor, agent, or lessee of such building, establishment, or place, to provide such safeguards or safety devices, or to make such alterations or additions or to make the changes in methods of operation by him deemed necessary for the safety and protection of the employees or other persons endangered by such conditions, and it shall be the duty of the person or persons receiving such notice to use all proper diligence to comply with the recommendations contained in said notice, and immediately upon completion thereof to mail or deliver a written notice to the commissioner of labor at Topeka, Kansas, stating that said safeguards or safety devices have been provided or that said alterations or additions or changes in methods of operation have been fully made, and if such safeguards or safety devices are not provided, or said alterations or additions, or changes in methods of operation are not made, and the commissioner of labor notified thereof, as provided herein, within thirty days, or within such time as such safeguards or safety devices can be provided or said alterations or additions or said changes in methods of operation can be made, and the commissioner of labor notified thereof, with proper diligence upon the part of such owner, proprietor, agent or lessee, said owner, proprietor, agent or lessee so notified

shall be deemed guilty of a misdemeanor, and upon complaint of the commissioner of labor, as State factory inspector, or his deputy or special agent, before a court of competent jurisdiction, and upon conviction thereof shall be fined in a sum of not less than twenty-five dollars nor more than two hundred dollars, or by imprisonment not more than ninety days, or by both such fine and imprisonment.

Sec. 3. This act shall take effect and be in force from and after its publication in the official State paper.

Approved March 8, 1917.

Published March 26, 1917.

MASSACHUSETTS

PRACTICE OF THE MASSACHUSETTS BUILDING INSPECTION DEPARTMENT OF THE DISTRICT POLICE

"This Department has no regulations relating to the heating and ventilating of factory buildings, but such work is taken up only in special cases by the State Board of Labor and Industries, and applies to factories where buffing and grinding wheels, etc., are used; and to the ventilation of sanitariums in factory buildings. The matter of heating and ventilating factories has not been compulsory except in special cases in certain factories on account of the processes used in manufacturing and also on account of the number of employees distributed in rooms to operate the machines, etc. The Massachusetts law provides that, if so directed, plans for heating and ventilation shall be filed with the plan of the building thereof."—J. J. CAREY, Deputy Chief.

MICHIGAN

In Michigan, a law provides for exhaust systems for carrying off dust from emery wheels and grindstones and dust creating machinery "wherever deemed necessary by the factory inspector." There is also a rule covering the ventilation of foundries and detailed directions are given for complying with the law.

MINNESOTA

The Minnesota law after specifying that each employee must have not less than 400 cu. ft. of air space unless reduced by a special order of the Commissioner of Labor, goes on to provide for "sufficient means of ventilation" where excessive heat is created, or if steam, gases, vapors, dust or other impurities that might be injurious to health, are generated.

NEW JERSEY

The New Jersey law provides for exhaust systems in workshops for the removal of industrial dust, noxious fumes, excessive heat and humidity. Regarding sizes of rooms, it is specified that not less than 250 cu. ft. of air space shall be provided for each employee, between 6 a. m. and 6 p. m., and not less than 400 cu. ft. of air space between 6 p. m. and 6 a. m. Regarding the ventilation of the factory itself, the law, as amended by act approved February 26th, 1912, reads as follows:

"The owner, agent or lessee of a place coming under the provisions of this act shall provide, in each workroom thereof, proper and sufficient means of ventilation, and shall maintain proper and sufficient ventilation; if excessive heat be created or if steam, gases, vapors, dust or other impurities that may be injurious to health be generated in the course of the manufacturing process carried on therein, the room shall be ventilated in such a manner as to render them harmless, so far as is practicable; in case of failure, the Commissioner of Labor shall order such ventilation to be provided."

Compliance with the law must be made within twenty days on penalty of \$10.00 fine for each day beyond that limit. Exhaust fans must also be provided in foundries where smoke, steam, dust or noxious gases are not promptly carried off by the general ventilation. The requirements for mercantile establishments state that "the owner, agent or lessee of a place coming under the provision of this act, or employer, shall provide in each mer-

cantile establishment proper and sufficient means of ventilation; in case of failure, the commissioner shall order such ventilation to be provided."

A similar penalty clause is added as for workrooms.

The State Department of Labor publishes a pamphlet on "Sanitary and Engineering Industrial Standards" for workshops in the State.

NEW YORK

Under the present so-called "Labor Law" in New York State all matters pertaining to the heating and ventilation of industrial buildings are in the hands of an industrial commission under whose direction the State Department of Labor is conducted. According to the law, this commission "shall have the power to make rules and regulations for and fix standards of ventilation, temperature and humidity in factories and may prescribe the special means, if any, required for removing impurities or for reducing excessive heat, and the machinery, apparatus or appliances to be used for any of said purposes, and the construction, equipment, maintenance and operation thereof, in order to effectuate the purposes of this section."

The law also provides for a bureau of inspection which includes the bureau of factory inspection.

The general terms of the law covering factory ventilation are as follows:

Section 86. 1. The person operating every factory shall provide in each workroom thereof, proper and sufficient means of ventilation by natural or mechanical means, or both, as may be necessary, and shall maintain proper and sufficient ventilation and proper degrees of temperature and humidity in every workroom thereof at all times during working hours.

2. If dust, gases, fumes, vapors, fibers or other impurities are generated or released in the course of the business carried on in any workroom of a factory, in quantities tending to injure the health of the operatives, the person operating the factory, whether as owner or lessee of the whole or a part of the building in which the same is situated, or otherwise, shall provide suction devices that

shall remove said impurities from the workroom at their point of origin where practicable, by means of proper hoods connected to conduits and exhaust fans of sufficient capacity to remove such impurities, and such fans shall be kept running constantly while such impurities are being generated or released. If, owing to the nature of the manufacturing process carried on in a factory workroom, excessive heat be created therein, the person or persons operating the factory as aforesaid shall provide, maintain, use and operate such special means or appliances as may be required to reduce such excessive heat.

As regards mercantile establishments a special section (Section 168-f) states that "every mercantile establishment shall be provided with proper and sufficient means of ventilation by natural or mechanical means, or both, as may be necessary and there shall be maintained therein proper and sufficient ventilation and proper degrees of temperature and humidity at all times during working hours. The industrial board shall make rules for and fix standards of ventilation, temperature and humidity in mercantile establishments."

RULES MADE BY THE INDUSTRIAL COMMISSION

In accordance with the foregoing sections of the "Labor Law," the Industrial Commission has promulgated a number of rules which have come to be known as the "Industrial Code." They are published, as compiled up to July 1, 1916, by the State Department of Labor, together with the law itself.

Following are the rulings bearing on the matters of heating and ventilation:

Rule 160. Ventilation. Every dressing room shall have at least one window or skylight opening directly to the outdoor air or air shaft, which shall be so constructed and

maintained as to be easily opened at least one-half of its required area, except that in case a separate hospital or emergency room is provided and maintained at all times for the exclusive use of females and such room has a window or skylight opening to the outdoor air, the dressing room shall not be required to have such window or skylight.

Rule 161. Every dressing room, washroom or locker room enclosed by walls which extend to the ceiling, unless provided with windows which have an area opening directly to outdoor air, not less than one-tenth of the floor area, shall have exhaust ventilation equal to not less than six changes of air per hour at all times when such rooms are in use. A skylight shall be deemed the equivalent of a window, provided that it has fixed or movable louvres with openings of the net openable area prescribed for such window. In any such room, enclosed by walls which do not extend to the ceiling, the commissioner may require such ventilation as may be necessary.

Rule 162. Heating and Illumination. Every dressing room shall be heated to a temperature of not less than 58° F., and shall be so lighted that all parts of the room are easily visible. If daylight is not sufficient for this purpose, artificial illumination shall be maintained at all times when the room is in use.

Rule 556 refers to the removal of smoke, steam, gases and dust from foundries. It is specified that "where smoke, steam, gases or dust arising from any of the operations of the foundry are dangerous to health and where a natural circulation of air does not carry off such smoke, steam, gases or dust, there shall be installed and operated hoods, ventilators, fans or other mechanical means of ventilation approved by the commissioner of labor."

Rules 700-716 gives the appliances to be applied for the removal of dust, gases and fumes from grinding, polishing and buffing wheels, including the sizes of branch pipes, size of main pipes and fan inlets and outlets suction, arrangement and construction of pipes, etc.

Rule 718 provides for the removal of fumes, vapors and gases emitted or created in connection with some twenty special processes of manufacture.

Rule 721 gives similar arrangements for the removal of lead dusts and fumes in the manufacture or use of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate or fluo-silicate, or in the manufacture of pottery, tiles or porcelain enameled sanitary ware, including the corroding or oxidizing of lead, and the crushing, mixing, sifting, grinding and packing of all lead salts or other compounds.

"Recommendations for the size of the cyclone separator or dust collector," states the code, "are hard to give, as the separator must be proportioned to suit operating conditions, light dusts requiring a larger separator than heavy dusts. The following table, reproduced from the catalogue of a prominent separator manufacturer, gives dimensions of separators stated to be suitable for metallic dusts and wood shavings. A separator should be selected the area of whose inlet is at least as large as the area of the discharge pipe from the fan. For light buffing dusts, lint, etc., the air outlet from the top of the separator should be so large that the velocity of discharge will not exceed 300 to 480 ft. per minute; a separator should be selected of which the other dimensions are proportionate. The air outlet should be provided with a proper canopy or elbow to exclude the weather, but should be otherwise unobstructed. There should be ample clearance under the separator for the accumulation or storage of the dust which

Dust Separators

Diameter of fan outlet in inches	Area of fan outlet in square inches	OPENINGS IN SEPARATOR						DIMENSIONS OF SEPARATOR			Shipping weight, lbs.
		Size of inlet in inches	Area of inlet in square inches	Diameter of air outlet in in- ches	Area of air out- let in square inches	Diameter of dust outlet in inches	Outside diame- ter of cylinder in inches	Height of cyl- inder in in- ches	Length of cone in inches		
5...	20	2½ x 9	23	8½	56	3	29½	14	26½	70	
6...	28	3 x 10½	32	10	78	4	35½	15½	32½	100	
7...	38	3½ x 13	47	13	132	6	41½	18½	37½	140	
8...	50										
9...	63	4½ x 16	72	15	176	6	47½	21	43½	175	
10...	78	5 x 18	90	17	227	6	53½	23	50	245	
11...	95	5½ x 21	115	20	314	10	59½	26	56	315	
12...	113										
13...	133	6½ x 24	156	23½	433	10	65½	29	61½	395	
14...	154										
15...	177	7 x 27	189	26	531	10	71½	32	67½	490	
16...	201	8 x 30	240	28	615	10	77½	35	72½	575	
17...	227										
18...	254	8½ x 32	272	31	754	10	83½	38	77½	715	
19...	283	9 x 35	315	33	855	10	89½	41	82½	875	
20...	314										
21...	346	9 x 40	360	36	1,017	10	93½	46	85½	930	
22...	380	10 x 41	410	39	1,194	10	97½	47	89	1,000	
23...	415	10½ x 43	451	41	1,320	11	101½	49	93	1,095	
24...	452										
25...	491	11 x 45	495	44	1,520	11	105½	51	97	1,455	
26...	531	11 x 48	528	46	1,662	12	109½	54	99½	1,600	
27...	572	11 x 51	561	49	1,885	12	113½	57	103½	1,700	
28...	621	11½ x 54	621	52	2,123	12	117½	60	109½	1,855	
29...	660	12 x 57	684	55	2,375	12	121½	63	111½	2,035	
30...	707	12 x 60	720	58	2,642	12	125½	66	115½	2,155	
31...	754	12½ x 63	807	61	2,922	13	129½	69	118½	2,250	
32...	804										
33...	855	13 x 66	858	64	3,217	13	133½	72	122½	2,420	
34...	908	13½ x 69	932	67	3,525	13	137½	75	126½	2,555	
35...	962	14 x 72	1,008	70	3,848	14	141½	78	129½	2,745	
36...	1,017	14½ x 75	1,087	73	4,185	14	145½	81	133½	2,900	
37...	1,075										
38...	1,134	15 x 78	1,170	76	4,536	14	149½	84	137½	3,065	
39...	1,194	15½ x 81	1,255	79	4,901	14	153½	87	141½	3,235	
40...	1,256										
41...	1,320	16 x 84	1,344	82	5,281	14	157½	90	145½	3,395	

should never be allowed to pile up as high as the bottom of the separator.

"To give a sample illustration, the appended drawing shows an exhaust system laid out in conformity with these specifications for eight 14-in. emery wheels. For eight 14-in. buffing wheels, the branch pipes would have to be not less than $4\frac{1}{2}$ in. in diameter, and the increased size of the main suction duct and the fan determined in accordance with Rule 703. The main discharge pipe and the cyclone separator should be considerably larger for buffing wheels than for emery wheels.

"The following table gives the diameter in inches of the main suction duct at any point for any number of uniform-size branch pipes when the area of the main at any point is made equal to the combined areas of the branch pipes preceding that point plus 20%, the minimum required by these specifications."

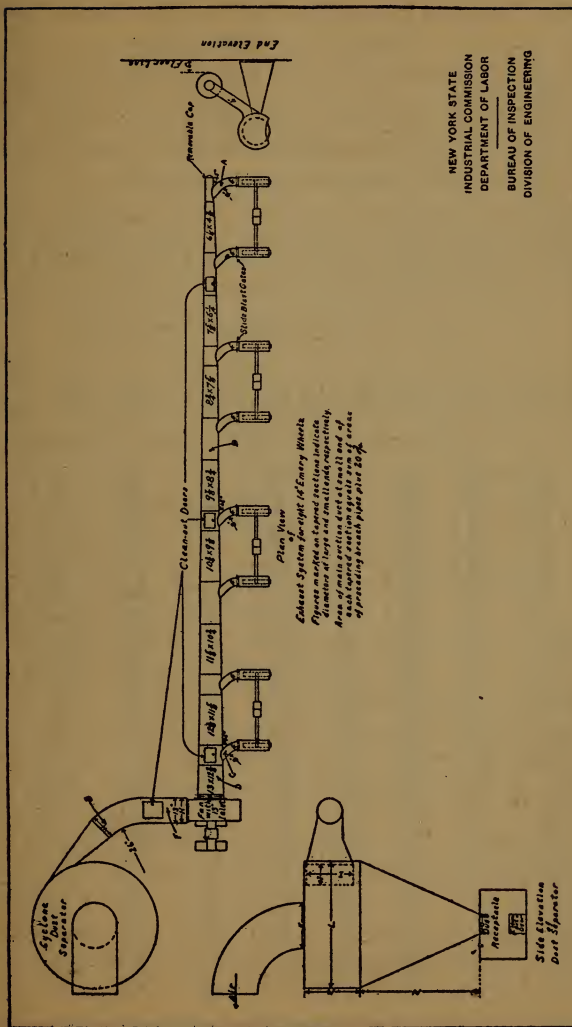
Violations of the provisions of the labor law are punished by fines running from \$20.00 to \$50.00 for the first offense. Second and third offenses incur penalties running up to \$250.00 and imprisonment of 60 days.

PRACTICE OF THE NEW YORK STATE INDUSTRIAL COMMISSION

"It is a customary practice in the Department when we find it necessary to install exhaust systems for the purpose of carrying away dust and gases, etc., to issue orders and set a time when compliance is necessary."—JAMES L. GER-
NON, First Deputy Commissioner, Bureau of Inspection.

THE PRACTICAL REQUIREMENTS OF THE NEW YORK STATE FACTORY VENTILATION LAW

The following series of questions and answers were sent out to owners and landlords of factory buildings in New York State by the State Factory Inspector.



Number of branch pipes	Diameter of branch pipes in inches								
	3	3½	4	4½	5	5½	6	6½	7
	Area of each branch pipe in square inches								
	7.07	9.62	12.566	15.9	19.635	23.758	28.274	33.183	38.485
	Area of each branch pipe plus 20% (square inches)								
	8.484	11.544	15.08	19.08	23.562	28.51	33.93	39.82	46.182
1. .	3½	3½	4½	5	5½	6	6½	7½	7½
2. .	4½	5½	6½	7	7½	8½	9½	10½	10½
3. .	5½	6½	7½	8½	9½	10½	11½	12½	13½
4. .	6½	7½	8½	9½	11	12½	13½	14½	15½
5. .	7½	8½	9½	11	12½	13½	14½	16	17½
6. .	8½	9½	10½	12½	13½	14½	16½	17½	18½
7. .	8½	10½	11½	13½	14½	16	17½	18½	20½
8. .	9½	10½	12½	14	15½	17½	18½	20½	21½
9. .	9½	11½	13½	14½	16½	18½	19½	21½	23
10. .	10½	12½	13½	15½	17½	19½	20½	22½	24½
11	11	12½	14½	16½	18½	20	21½	23½	25½
12. .	11½	13½	15½	17½	19	20½	22½	24½	26½
13	11½	13½	15½	17½	19½	21½	23½	25½	27½
14	12½	14½	16½	18½	20½	22½	24½	26½	28½
15. .	12½	14½	17	19½	21½	23½	25½	27½	29½
16. .	13½	15½	17½	19½	22	24½	26½	28½	30½
17	13½	15½	18½	20½	22½	24½	27	29½	31½
18	14	16½	18½	21	23½	25½	27½	30½	32½
19	14½	16½	19½	21½	23½	26½	28½	31½	33½
20	14½	17½	19½	22½	24½	27	29	31½	34½
21	15½	17½	20½	22½	25½	27½	30½	32½	35½
22. .	15½	18	20	23½	25½	28½	30½	33½	36
23	15½	18½	21½	23½	26½	29	31½	34½	36½
24. .	16½	18½	21½	24½	26½	29½	32½	34½	37½
25. .	16½	19½	22	24½	27½	30½	32	35½	38½
26	16½	19½	22½	25½	28	30½	33½	36½	39½
27	17½	20	22½	25½	28½	31½	34½	37	39½
28	17½	20½	23½	26½	29	32	34½	37½	40½
29. .	17½	20½	23½	26½	29½	32½	35½	38½	41½
30	18	21	24	27	30	33	36	39	42

Q. What is meant by "proper and sufficient" ventilation?

A. As defined by Dr. John S. Billings, perfect ventilation means that any and every person in a room takes into his lungs at each respiration air of the same composition as that surrounding the building, no part of which has recently been in his own lungs or those of his neighbors, or which consists of the products of combustion generated in the building, while at the same time he feels no currents or drafts of air, and is perfectly comfortable as regards temperature, being neither too hot nor too cold.

Q. How much air is required to meet these conditions?

A. Not less than 2,000 cu. ft. per hour for each person, with the same amount per hour for each cu. ft. of gas consumed whether for light, heat or power.

Q. How can this amount of air be furnished?

A. By the use of mechanically driven fans, either forcing fresh air into a room, or exhausting the foul and vitiated air from the room. By either method, there is a positive and constant change of air, independent of atmospheric or climatic changes.

Q. When machines using gas are properly hooded, is the above amount of air necessary?

A. No, if the products of combustion are directly removed from a room, there are no poisonous gases to dilute with fresh air, and therefore no further provision need be made, in so far as these hooded machines are concerned.

Q. My building is provided with windows on two, three or four sides. Won't windows provide proper ventilation?

A. No. The result of hundreds of air tests made by our medical inspector during the past year, indicates that

windows, even when opened, will not provide adequate ventilation in all parts of a room. The air is naturally better near the windows than it is farther away, while due consideration must be given to the fact that windows are primarily designed for lighting. Every one knows that windows are generally closed tightly during cold weather, the slightest cold draft being objectionable to employees. Even though windows were used for the purpose of ventilation, the direction and velocity of the wind, changing temperature, climatic and other conditions would make such ventilation largely a matter of guesswork.

Q. Will it suffice to put a few little fans in the windows, which revolve by action of the escaping air?

A. No, such fans do little if any good. They are nothing but miniature wind-mills; when a current of air strikes the blades, the fan revolves. Probably as much air would pass through the opening in the window if no fan were used.

Q. Will not skylights furnish proper ventilation?

A. There is the same objection to skylights as to windows. If used for ventilating purposes they produce uncomfortable drafts of air, and we find in practically every factory that they are tightly closed, and are nothing more than the name implies—skylights.

Q. Will not the introduction of a sufficient amount of cold air lower temperature of workroom to such a degree as to be uncomfortable?

A. Possibly, and in that event it will be necessary to heat the incoming fresh air, or else supply more heat in the workroom.

Q. Where shall I place the fan—what size fan—are ducts necessary—where should fresh air be admitted or foul air removed—how much heating surface?

A. All the foregoing and other questions of similar

character, are matters of detail which should be entrusted to the ventilating contractor whom you select to do your work.

Q. How am I to know that the system which I may install will be satisfactory to the Bureau of Factory Inspection?

A. We are willing to examine any plans which you may submit and if found satisfactory to approve them. Should changes appear necessary, tending toward economy or efficiency, in either installation or maintenance, you will be so advised.

OHIO

"The Ohio laws governing factory and building inspection states in Section 898 that each district inspector of workshops and factories assigned to a district for the inspection of shops and factories therein, shall carefully inspect the sanitary conditions, system of sewerage * * * system of heating, lighting and ventilating rooms where persons are employed at labor," etc.

Under the power conferred by Section 996, if he finds "that the heating, lighting, ventilation or sanitary arrangements of a shop or factory are injurious to the health of persons employed or residing therein, * * * he shall notify the owner, proprietor or agent of such shop or factory or building by personally serving a notice in writing or mailing it to his last known address, to make the necessary alterations or additions. Said notice shall describe the alterations and addition which shall be installed therein and the time in which each alteration or addition therein required shall be made and each appliance installed."

Penalties are provided running from \$50.00 to \$100.00 per day after the expiration of the time limit set by the inspector for making required changes.

The term "shops and factories" includes the following: Manufacturing, mechanical, electrical, mercantile, art and laundering establishments, printing, telegraph and telephone offices, railroad depots, hotels, memorial buildings, tenement and department (apartment) houses.

In connection with the safe-guarding of machinery, owners and operators of shops and factories are required to make suitable provision for emery wheels and for metal

and wood-working machinery generally. The various requirements and the methods prescribed for fulfilling them are given in detail in the code.

The penalty for failing to comply with the provisions of the code within 30 days vary from \$100.00 to \$300.00 for each offense.

Additional provisions are included (Section 6330-2) covering especially dangerous works or processes, such as the manufacture of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate, or flue-silicate. In such cases "every employer shall without cost to the employees, provide * * * devices, means and methods for the protection of his employees who, while engaged in any work or process included in section 2 are exposed to lead dusts, lead fumes or lead solutions:

"(a) Working rooms, hoods and air exhausts for the protection of employees engaged in any work or process which produces lead dusts or lead fumes. The employer shall provide and maintain work rooms adequately lighted and ventilated, and so arranged that there is a continuous and sufficient change of air, and all such rooms shall be fully ventilated and separated by partition walls from all departments in which the work or process is of a non-dusty character; and all such rooms shall be provided with floor, permitting an easy removal of dust by wet methods or vacuum cleaning, and all such floors shall be so cleaned daily.

"Every work or process referred to (given above) including the corroding or oxidizing of lead, and the crushing, mixing, sifting, graining and packing of all lead salts or other compounds shall be so conducted and such adequate devices provided and maintained by the employer as to protect the employee, as far as possible from contact with lead dust or lead fumes. Every kettle, vessel, re-

ceptacle or furnace in which lead in any form referred to is being melted or treated, and any place where the contents of such kettles, receptacles or furnaces are discharged, shall be provided with a hood connection with an efficient air exhaust; all vessels or containers in which dry lead in any chemical form or combination referred to, is being conveyed from one place to another within the factory, shall be equipped, at the places where the same are filled or discharged, with hoods having connection with an efficient air-exhaust; and all hoppers, chutes, conveyors, elevators, separators, vents from separators, dumps, pulverizers, chasers, dry pans, or other apparatus for drying pulp lead, dry-pans dump, and all barrel packers and cars of other receptacles into which corrosions are at the time emptied, shall be connected to an efficient dust-collecting system; such system to be regulated by the discharge of air from a fan, pump, or other apparatus, either through a cloth dust-collector having an area of not less than $\frac{1}{2}$ sq. ft. of cloth to every cubic foot of air passing through it per minute, the dust collector to be placed in a separate room which no employee shall be required or allowed to enter, except for essential repairs, while the works are in operation; or such other apparatus as will efficiently remove the lead dusts from the air before it is discharged into the outer air."

In Cleveland, Ohio, a new building code became effective October 14, 1913. It is known as Ordinance No. 29,798. This code has the following relating to "factories and workshops":

"Every building, room or part thereof hereafter erected for, or converted to use as a factory or workshop in which there shall be less than 20 sq. ft. of floor space for each employee or occupant, shall have in operation, while occupied, a mechanical system of ventilation so designed and

installed as to provide at least six complete air changes per hour.

"Unless natural ventilation is provided as required by the ordinances of the City of Cleveland, and maintained while occupied, every factory in which there is more than 20 sq. ft. of floor space for each employee or occupant, shall have in operation, while occupied, a system of ventilation so designed and installed as to provide at least four complete air changes per hour."

PRACTICE OF THE INDUSTRIAL COMMISSION OF OHIO

"The specific requirements for the construction of factories (Title 7) has not yet been adopted by this Department. The heating systems approved in this Department for factory construction are either a direct steam or blast system, or may be a furnace blast system. The only ventilation required in factories is that which is obtained through the windows. The new, modern type of factory construction has considerable glass area for light. Either double-hung windows, or pivoted sash are used, and we find the ventilation in these cases very satisfactory. However, we find in some of the old factory buildings a very limited amount of windows and the air in these cases is very bad. Then it is necessary for the Chief to exercise his authority by ordering some type of ventilation to be installed."—GEORGE H. HAMILTON, Chief Deputy, Department of Inspection.

PENNSYLVANIA

The Pennsylvania requirements regarding blowers and exhausters for use with grinding and polishing machinery, are enforced by the Industrial Board of the state. This board publishes a set of directions covering suction test and piping, and other features.

WISCONSIN

The requirements in Wisconsin are in the form of general orders of the State Industrial Commission. Order No. 2,000 deals with hoods for grinding, buffing and polishing wheels.

Orders No. 2,001-2,006 deal with suction pipes for hoods, amount of suction required, position of main pipe and dust collector.

Orders No. 2,007 to 2,010, cover belts, drums, rolls and disks for grinding, buffing, polishing or sanding; sand blasts and tumbling barrels.

Orders No. 2,011 to 2,013 deal with machines which create dust, vats and tanks which emit fumes, and furnaces and forges.

Order No. 2,014 provides for the ventilation of foundries, forgeshops and roundhouses.

Order No. 2,015 covers workrooms where there is less than 900 and more than 300 cu. ft. of air space per person. All such rooms in which there is no smoke, gas, fumes, dust, vapors or fires consuming oxygen "must be provided

with a ventilating system which will furnish 1,800 cu. ft. of fresh air per hour to each person. Additional ventilation must be provided where there are lights or fires in such rooms."

Other rooms containing 900 cu. ft. of air space per employee "must be provided with a ventilating system which will change the air in the room not less than twice each hour. Such system must be so designed as not to produce injurious drafts or reduce the temperatures materially below the average temperature maintained."

Order No. 2,205 reads: "In each toilet room heretofore installed, and which is so located that it is impossible to secure light and air directly from the outside, a flue or mechanical ventilating system must be installed which will provide adequate ventilation.

"In Wisconsin the Industrial Commission has power to issue orders for any changes in existing and new systems. The factory head may make an appeal from the agents ruling and if the majority of the commission decides against him, he must make the required changes. This decision can only be reached after the majority of the commission have visited his factory personally and examined the existing conditions."

SMOKE PREVENTION CODES FOR LARGE AND SMALL CITIES

The following typical ordinance, designed to meet the requirements of the small city, was drawn up by Osborn Monnett, of the American Radiator Company, formerly smoke inspector for the Chicago Smoke Inspection Department.

The ordinance as presented may be easily modified to the uses of a large city. In that case it would call for a chief assistant smoke inspector and several deputies, according to the size of the force that was desired to use.

With a larger staff of engineers the ordinance should also have a clause incorporating the requirement that installations be followed up for a test run made under operating conditions to decide whether or not the plant was satisfactory from the smoke standpoint. In the event that it was not, alterations should be made. After the plant was determined to be satisfactory, then a certificate of operation would be issued, fee for which would be included in the original permit fee.

Following is the model ordinance in full for a small city:

An ordinance providing for smoke inspection and abatement especially adapted for a small city.

AN ORDINANCE

Providing for smoke inspection and abatement in the City of _____.

Be it ordained by the City Council of the City of _____ as follows:

Sec. 1. There is hereby created the office of smoke inspector, the compensation and duties connected therewith to be as hereinafter specified.

Sec. 2. The smoke inspector shall be appointed by the Mayor by and with the consent of the City Council, and shall perform the duties of his office until removed from office by the Mayor or until the Mayor by and with the consent of the City Council has appointed his successor.

Sec. 3. The person so appointed shall be an engineer, qualified by training and experience in the theory and practice of the construction and operation of steam boilers and furnaces and also in the theory and practice of smoke abatement and prevention.

Sec. 4. The salary of the smoke inspector shall be _____ dollars (\$ _____) per annum.

Sec. 5. The said inspector is authorized to employ one clerk, to be selected from the civil service list of the city and the clerk shall attend to such duties as the inspector shall direct and be paid according to civil service rating in the manner fixed by law.

Sec. 6. The Mayor shall appoint a smoke abatement commission composed of three representative citizens, one of whom shall be a mechanical engineer of recognized standing, who shall act without remuneration as advisors to the Mayor and to the smoke inspector on matters pertaining to the organization or the conduct of the smoke abatement work, or both. The smoke inspector shall at all times receive and place on file all suggestions, recommendations, advice, or other communications that may be submitted to him in writing by the smoke abatement commission.

Sec. 7. No new plants or any reconstruction of any old plants for producing power and heat, or either of them, except for detached private residences, or for buildings

used exclusively for private residence purposes, in which the number of families occupying apartments shall be less than six, shall be erected or maintained in the city until plans and specifications of the same have been filed in the office of and approved by the smoke inspector and a permit issued by him for such erection, reconstruction or maintenance. The plans and specifications to be filed with the smoke inspector shall show the amount of work and the amount of heating to be done by such plant and all appurtenances thereto, including all provisions made for the purpose of securing complete combustion of the fuel to be used, for the purpose of preventing smoke; said plans and specifications shall also contain a statement of the kind of fuel proposed to be used, including the commercial size of coal when such fuel is specified, and said plans and specifications shall also show that the room, apartment or basement in which such plant shall be located is provided with doors, windows, air shafts, fans and other means of ventilation sufficient to prevent the temperature of such room, apartment, basement or other portion of such building wherein such plant or apparatus is to be used, from rising to a point higher than 120 degrees Fahrenheit; and sufficient also to provide that the atmosphere of any such room, apartment or basement wherein such apparatus may be located, may be entirely renewed every ten minutes.

Upon the approval of such plans and specifications, a duplicate set of which shall be left on file in said office, and upon the payment of the fees hereinafter provided, the smoke inspector shall issue a permit for the construction, erection or maintenance of such plant. As soon as the smoke inspector has examined the plans and specifications submitted and has issued a permit as above provided, he shall then notify the Commissioner of Build-

ings to see that the execution of the work permitted is carried out in conformity with the plans and specifications, with special reference to the amount of space used, the size and construction of the chimney or chimneys used, the provision for the prevention of smoke and the provision for ventilation, and the proper temperature in the room, apartment or basement.

Sec. 8. It shall be unlawful for any person to use any new or reconstructed plant for the production and generation of power and heat, or either of them, except for detached private residences or buildings used exclusively for private residence purposes in which the number of families occupying apartments shall be less than six, until he shall first have procured a statement from the smoke inspector that the plant is constructed in accordance with the plans and specifications filed with the smoke inspector at the time the permit was issued.

Sec. 9. No owner, lessee, or operator of any existing plant shall alter or repair any chimney or any old furnace or device, which alteration, change or installation shall affect the method or efficiency of preventing smoke, without first submitting plans and specifications to the smoke inspector and securing a permit therefor; however, that minor necessary or emergency repairs which do not change the capacity of such plant or which do not involve any substantial alteration in structure and which do not involve any alteration in the method or efficiency of smoke prevention may be made by or under the engineer in charge of said plant without a permit. Any person who shall violate sections 7, 8 or 9 shall be liable to a fine of \$25.00 for each day upon which he shall prosecute such erection, construction, alteration, change, or installation, or use any new or reconstructed plant without a permit, and each day's violation shall constitute a separate offense.

Sec. 10. The emission of dense smoke within the city from the smokestack of any locomotive, steamboat, or steam tug for a period of more than one minute, except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein, is hereby declared a nuisance.

The emission of dense smoke within the city from the smokestack of any steam roller, steam derrick, steam pile driver, tar kettle or other machine or contrivance, or from the smokestack or chimney of any building or premises, or from any open bonfire, open bin, tank, vat, basin or other receptacle except for a period or periods aggregating not to exceed six minutes in any one hour during which period or periods the firebox or boxes are being cleaned or a new fire or fires are being built therein is hereby declared a nuisance.

Any nuisance such as the above specified may be summarily abated by the smoke inspector, or by any one whom he may duly authorize for the purpose, and such abatement may be in addition to the fine hereinafter provided.

Any person or persons, or corporation owning, operating, or in charge or control of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar machine or contrivance, or any open bonfire, open bin, tank, vat, basin or other receptacle, or of any building or premises, who shall cause or permit the emission of dense smoke within the city, in contravention of the provision of this section, from the smokestack of any locomotive, steamboat, steam tug, steam roller, steam derrick, steam pile driver, tar kettle, or other similar

machine or contrivance, or from any open bonfire, open bin, tank, vat, basin, or other receptacle, or from the smoke-stack or chimney of any building or premises so owned, controlled, or in charge of him, her, or them, shall be deemed guilty of a violation of the ordinance, and upon conviction thereof shall be fined not less than ten dollars (\$10.00) nor no more than one hundred dollars (\$100.00) for each offense; and each day of such emission of dense smoke shall constitute a separate offense.

For the purpose of grading the density of smoke, the Ringelmann smoke chart, as published and used by the Federal Bureau of Mines, shall be the standard of comparison. Smoke shall be considered "dense" when it is of equal or greater density than No. 3 of the chart.

Sec. 11. A fee of one dollar (\$1) shall be charged for the inspection of plans and specifications for the erection, reconstruction, or alteration of any plant, this fee to include the issuing of a permit, in case such permit is granted.

The smoke inspector may and he is hereby directed and instructed to remit all inspection or examination fees charged, or that hereafter may be charged, against any and all charitable, religious, and educational institutions when the furnace or other device or apparatus inspected is located in or upon premises used and occupied exclusively by such charitable, religious, or educational institutions; provided, that such charitable, religious, or educational institution is not conducted or carried on for private gain or profit; and provided further, that the smoke inspector may require every application for the remission of such fees to be verified by the affidavit of one or more taxpayers of the city.

Sec. 12. Prosecution for all violations of this ordinance

shall be instituted by the smoke inspector and shall be prosecuted in the name of the City of _____.

The issuance and delivery by the smoke inspector of any permits for the construction or reconstruction, or any permit for the alteration or repair of any plant or chimney connected with a plant, or the exemption of any class of buildings from the necessity of taking out a permit, shall not be held to exempt any person or corporation to whom any such permit has been issued or delivered, or who has been exempt from such permit, from prosecution on account of the emission or issuance of dense smoke caused or permitted by any such person or corporation.

Sec. 13. Any person who shall violate any of the provisions of this ordinance (except as is herein otherwise provided) shall be fined not less than \$25 nor more than \$100 for each offense.

Sec. 14. The City shall provide such instruments, books, papers, and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment as shall be necessary for the proper performance of the duties of the members of the department. The smoke inspector shall have charge of such instruments, books, papers and equipment, and shall deliver same to his successor in office.

Sec. 15. The smoke inspector shall cause to be kept in his office a complete record of all permits issued and of all examinations of plants made by members of the department and also of all certificates issued.

Sec. 16. The smoke inspector shall make a report of the work of his department to the Mayor and City Council, annually, on or before the first day of February, and at other times as often as required by the City Council.

Sec. 17. If any person on behalf of the City under the provisions of this chapter shall take or receive any money or any valuable thing for the purpose of favoring any person or persons, he shall be dismissed from the service.

Sec. 18. This ordinance shall take effect on and after its passage and publication.

REQUIREMENTS FOR MODEL COMPULSORY HEATING AND VENTILATION LAWS

Minimum Provisions for Public and Semi-Public Buildings Promulgated by the American Society of Heating and Ventilating Engineers

Report of the committee appointed January, 1914, to prepare a set of minimum ventilation requirements for public and semi-public buildings which the society can recommend for legislation.

GENERAL STATEMENT

A correct interpretation of the experimental work which has been carried on, relating to ventilation practice, forces certain conclusions:

A. The necessity for adequate ventilation has been emphasized although the relative importance of certain factors has changed.

B. A high temperature, especially if associated with a high relative humidity, is injurious.

C. The proper relation between air temperature and relative humidity should be emphasized.

D. Air movement in contact with the body materially assists normal heat dissipation.

E. Air supply free from dust, bacteria and other contaminations is important.

We believe that the importance of the following requirements in compulsory ventilation laws has been amply demonstrated:

1. A minimum allotment per person of floor and air space based upon the nature of occupancy.
2. A quantitative minimum air supply requirement.

3. A carbon dioxide test for determining the quantity of air supply and its distribution.

4. A temperature range limitation.

5. The removal from the air of injurious substances arising from manufacturing processes or other causes.

6. Air exhaust requirements for special service rooms (toilets, locker rooms, etc.).

7. Definite requirements regarding the drawing, filing and approving plans for both new and existing buildings, in which ventilating equipments are to be installed or changes in the equipment made.

8. Ample authority to enforce the law without recourse to civil action, and with sufficient operative and financial assistance to care for the clerical, field and technical details incurred by such enforcement.

9. The official body charged with the enforcement of such laws shall have authority to promulgate specific rules and regulations covering details of installation and operation not included in the law. Such rules and regulations must not conflict with the full intent and meaning of the law.

Your committee has decided that it would be impractical to attempt to draft a model ventilation law for reasons herein given, and because this would require an extensive building classification which could not be satisfactorily used in the various states, cities or towns where building laws and regulations, based on other classifications, are now in force. The committee submits herewith first (under Section 1) the specific report covering general suggestions for minimum heating and ventilation requirements that are applicable to all classes of buildings, and second (under Sections II, III and IV) separate sets of more definite requirements for schools and colleges, factories and theatres.

Sections II, III and IV cover three very important classes of buildings, which are often the subject of separate legislation. Many other classes of buildings, such as Department Stores, Hospitals and similar institutions, Churches, Restaurants, Police Station, Jails, Bakeries, Laundries, etc., for which the requirements for heating and ventilation are covered by careful interpretation and use of Section I, would be benefited by separate sets of requirements. It is apparent also that suggestions from our society, covering practical requirements for the heating and ventilation of street cars and certain other public conveyances are desirable. This report could be considerably enlarged to cover these subjects.

The committee strongly urges that educational and co-operative methods of improving heating, ventilating and sanitary conditions be studied and used as far as possible in addition to compulsory methods.

The committee wishes to thank the various members of the society and others who have assisted in any way in the compilation of these recommendations. Whenever asked for, information was cheerfully given when such information was available. Acknowledgments are especially due the investigations and recent committee reports concerning the work in New York City and to the ventilation code and experience in the City of Chicago.

JAMES D. HOFFMAN, Chairman.

E. VERNON HILL.

FRANK T. CHAPMAN.

SECTION I

General Suggestions for the Compilation of Laws for Compulsory Ventilation

(Applicable to all Classes of Buildings.)

General: Sufficient and proper heating and ventilation shall be provided and maintained during occupancy in all rooms and all enclosed spaces, in all classes of buildings, to insure reasonable health and comfort conditions and maintain the requirements of Articles I to X inclusive.

Article I—Space Per Occupant (minimum requirement).

Schools and colleges—class, study, lecture and recitation rooms, floor area per occupant in square feet	15
Schools and colleges—class, study, lecture and recitation rooms, cubic space per occupant (volume divided by number of persons) in cubic feet.....	180
Primary schools—class and study rooms (pupils under 8 years of age), floor area per occupant in square feet.....	12.5
Primary schools—class and study rooms (pupils under 8 years of age), cubic space per occupant in cubic feet.....	150
Theatres, auditoriums and court rooms, floor area per occupant in square feet.....	6
Theatres, auditoriums and court rooms, space per occupant in cubic feet.....	90
Factories, manual training rooms and other work rooms—cubic space per occupant in cubic feet.....	250
Minimum space conditions in all classes of buildings or	

rooms not tabulated shall be reasonable and practical and shall meet the approval of the Department of Health.

Article II—Air Supply (minimum requirement).

Sufficient outdoor air shall be provided for all occupied rooms or enclosed spaces at all times during occupancy, as may be necessary to meet the requirements of Articles I to XI, inclusive.

The supply of outdoor air for the following classes of rooms shall be positive and based on a minimum quantity of air per occupant per hour as tabulated:

Class, study, lecture and recitation rooms in all schools and colleges, cubic feet per occupant per hour	1,800
Theatres, court rooms and other auditoriums.....	1,200
Factories, manual training rooms and other work rooms	1,500

All air supply for ventilation must be from an uncontaminated source of air from which the dust or other impurities, shall be sufficiently removed by washing, or otherwise, subject to the approval of the Department of Health.

Article III—Air Distribution.

The distribution and temperature of the air supply for ventilation shall be so arranged as to maintain the temperature requirement, as stated in Article IV, without uncomfortable drafts, or any direct draft lower than 60° F., and as a test of proper supply and distribution, it shall be required that the CO₂ content shall not at any time exceed 10 parts in each 10,000 parts of air based upon tests of air samples taken in a zone from 3 to 6 ft. above the floor line in any part of the occupied spaces. This re-

quirement may be modified by the Department of Health or other properly constituted authority as applying to breweries, water charging rooms or other rooms where carbon dioxide is liberated in manufacturing processes.

NOTE. While carbon dioxide in the air, in reasonable quantities, is not considered injurious to health, its presence in occupied rooms is an accurate measure of the air supply and distribution if no other source of carbon dioxide is present except the occupants of the room.

Article IV—Temperatures.

The temperature of the air in occupied rooms in all classes of buildings, during the periods of occupancy, shall be not less than 60° F., nor more than 72° F., except when the outside temperature is sufficiently high that artificial heating in the building is not required. This requirement shall not apply to foundries, boiler or engine rooms, or special rooms in which other temperatures are required or considered advisable as approved by the Department of Health.

Article V—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with the requirements of the Health, Fire, Building or Electrical Departments may be used both to warm the air supply for ventilation and to provide heat by direct radiation.

Article VI—Removal of Injurious Substances by Mechanical Exhaust or Other Practical and Positive Means.

Where dust, fumes, gases, vapors, odors, fibres or other impurities are created or released in the course of a business or process carried on in any work room or other

place in quantities tending to injure the health of occupants, there shall be provided canopies, hoods or other special devices, connected with an exhaust fan or fans of sufficient capacity and operated at sufficient pressure to remove such impurities at their point of origin. Such fans shall be kept running constantly while such impurities are being generated or released and shall discharge through ducts or flues to a point above the roof or otherwise and when so directed by the Department of Health, be provided with dust collectors or separators as may be necessary to safeguard the fresh air supply of the building or adjacent buildings and prevent any public nuisance. If practical and positive means, other than mechanical exhaust, can be devised for keeping these impurities from the air, such means may be used when formally approved by the Department of Health.

Article VII—Excessive Temperature and Humidity.

If, owing to the nature of the work done or the process carried on in a work room, factory, or other place of employment or occupancy excessive heat or humidity is caused therein, sufficient to be injurious to health, there shall be provided and maintained special means or appliances to reduce and control such excessive heat and humidity, as may be ordered by the Department of Health.

Article VIII—Special Service Rooms.

Public and semi-public locker rooms, coat rooms, dressing-rooms and wash rooms shall have exhaust ventilation equal to not less than six changes of air per hour, except where the window area opening directly to the outside air equals or exceeds $\frac{1}{8}$ of the floor area of the room, subject to the discretion of the Department of Health.

*Article IX—Toilet Room Ventilation.**(a)—Installations in New Buildings.*

Every toilet room or every water closet or urinal compartment shall be ventilated directly to the outer air by a movable window or by skylight with fixed or pivoted louvres. Every such room or compartment shall have a window or glass skylight not less than one foot wide and of an area of at least six square feet for one water closet or urinal. For every such additional fixture the area of the window or skylight shall be increased by at least one square foot. The Department of Health may require mechanical ventilation in addition to the above requirement where under any special conditions the window ventilation is deemed inadequate. The Department of Health may permit the installation of toilet rooms, water closet or urinal compartments with less window or skylight area than specified in this paragraph above, or without direct connection to the outer air, if a mechanical system of exhaust ventilation is provided, maintained and continually operated. This mechanical system shall consist of metal or smooth masonry ducts from the individual toilet rooms or compartments, to a fan or fans of sufficient capacity to exhaust a volume of not less than 35 cu. ft. of air per minute for each water closet or urinal. If the air is exhausted from within two feet of each fixture this amount may be reduced to 25 cu. ft. of air exhausted per minute per fixture, but in no case shall less than 6 changes per hour be allowed.

(b)—New and Existing Equipments in Old Buildings.

In existing buildings erected prior to the passage of this ordinance every toilet room or water closet or urinal compartment shall be ventilated to the outer air

by movable window; glass skylight with fixed or movable louvres, or by ventilating duct. Whenever any such toilet room having more than two fixtures (water closets or urinals) is ventilated solely by ducts, or whenever the window or skylight area is one-third less than the area required for "new buildings" positive ventilation complying with the requirements of subdivision (a) of this Article IX shall be installed and maintained if so ordered by the Department of Health. The Department of Health may, at its discretion, modify this requirement for four or less fixtures, or may require ventilation for two or less fixtures.

(c)—All Installations.

Every window or skylight mentioned in (a) and (b) of this Article shall be so constructed and maintained as to be easily opened at least one-half of its required area for windows and one-fourth its area for skylights. All exhaust fans used for ventilating toilet rooms shall exhaust to the outer air above the roof or at such points as not to cause offense to the occupants of the building or any other building or to create any public nuisance in the neighborhood.

(d)—Air Shafts.

Whenever any air shaft used for ventilating toilet rooms is covered by a skylight the net opening or openings available in such skylight shall be at least equal in area to the cross-sectional area of the shaft requirement.

Article X—Cellars.

All cellars, basements or spaces beneath buildings of any class or character shall be provided with windows or other means of ventilation and such cellars or spaces shall

be at all times properly ventilated and maintained in a dry and sanitary condition.

Article XI—Authorization.

The Department of Health is authorized to require additional or special ventilation or ventilating devices to cover any conditions which are unusual or require special treatment in occupied rooms or spaces in any class of buildings.

Article XII—Plans.

Before beginning the erection or alteration of any building the architect or contractor, owner, agent or party in possession or control, shall submit plans and specifications in duplicate showing and describing in detail the ventilating equipment contemplated. Such plans must be prints taken from tracings drawn to scale on cloth, in ink or by some process that will not fade or obliterate. The plans shall show accurately all necessary dimensions and details and shall be accompanied by a written statement giving the intended number of occupants of each room and the use of the room unless the plans clearly indicate these facts. Such plan and specifications must be submitted and approved by the Department of Health before work is allowed to proceed. During the erection or alteration of any such building inspections must be made by persons duly authorized by the Department of Health and after completion a certificate shall be issued which states that the ventilating equipment of such building complies in all respects with the approved plans and specifications and with the laws governing the same.

Article XIII—Officials Empowered to Enter.

The Commissioner of Health or his duly authorized assistants shall have the right to enter any building

covered by the provisions of the ventilation law, at any reasonable time, and at any time when occupied by the public, in order to examine such building and judge of the condition of the same and to discharge his duties pertaining thereto, and it shall be unlawful for any person or persons to interfere with him in the performance of this duty.

Article XIV—Officials Empowered to Close.

Where it is discovered that any violation of the ventilation law is existing in any building the Commissioner of Health shall give due written notice to correct the same. If after a reasonable period this notice is not complied with the Commissioner of Health shall have the power and it shall be his duty to close and keep closed to the public any such building or part thereof so long as the conditions of violation exist.

NOTE.—It will be observed that the committee has used the term "Department of Health" throughout its report, and while the committee recommends that the enforcement of the laws be entrusted to local health departments in cities and to State Boards of Health in smaller towns it is evident that, in many cases, the enforcement will be vested in other bodies, in which case the proper name of the body authorized should be substituted for the term "Department of Health" used in the recommendations.

SECTION II

Schools and Colleges

(Minimum heating and ventilating requirements applying specially to all Schools and Colleges. Supplementary to Section I.)

General: Sufficient and proper heating and ventilation shall be provided and maintained during occupancy in all rooms and all enclosed spaces in all classes of school and college buildings to insure health and comfort conditions, as required by the Department of Health.

Article I—Space Per Occupant.

a. A minimum of 15 sq. ft. of floor area and 180 cu. ft. of space per occupant shall be provided in each class, study, lecture, and recitation room, except that a minimum of 12½ sq. ft. of floor area and 150 cu. ft. of space may be accepted in class and study rooms for pupils under 8 years of age.

b. A minimum of 6 sq. ft. of floor area and 90 cu. ft. of space per occupant shall be provided in auditoriums and assembly rooms.

c. Minimum space conditions per occupant in all classes of rooms not tabulated shall be reasonable and practical and shall meet the approval of the Department of Health.

Article II—Air Supply Per Occupant.

Sufficient outdoor air shall be provided for all occupied rooms at all times during occupancy as may be necessary to meet the requirements of Articles II to VII, inclusive.

A positive supply of outdoor air shall, while school is in session, be provided the following rooms and the quantity of this positive air supply shall be equal to, or in excess of, the following minimum requirements per occupant per hour:

Class, study and recitation rooms.....	1,800 cu. ft.
Auditoriums, lecture or assembly rooms and libraries	1,200 cu. ft.
General and chemical laboratories.....	1,800 cu. ft.
Domestic science and manual training rooms..	1,800 cu. ft.

Offices, reception rooms, teachers' rooms, retiring rooms, play rooms, corridors, gymnasiums and lunch rooms, shall have approved ventilation, and the ventilation of gymnasiums shall be based upon a minimum of four changes of air in the room per hour, excepting specific cases, where the Department of Health shall have the power to modify this requirement.

The air supply for ventilation shall be taken from an uncontaminated source, or the air supplied must be air from which the dust or other impurities shall be sufficiently removed by washing, filtering or other approved method.

Article III—Air Distribution.

The distribution and temperature of the air supply for ventilation shall be so arranged as to maintain the temperature requirement of the following Article IV, without uncomfortable drafts or any direct draft lower than 60° F., and as a test of proper air supply and distribution, it shall be required that the CO₂ content shall not be allowed to exceed 10 parts in each 10,000 parts of air, based upon tests of air taken in a zone from 3 to 6 ft. above the floor line in any part of the occupied spaces.

Article IV—Temperature.

The temperature of the air in the various rooms and spaces within the building during the period of occupancy shall be maintained at all times throughout all occupied spaces within the ranges given in the following schedule, except when the outside temperature is sufficiently high that artificial heating in the building is not required:

Class, study, and recitation rooms.....	65° to 70° F.
Auditoriums, lecture, and assembly rooms...	64° to 68° F.
General laboratories, domestic science and manual training rooms.....	62° to 68° F.
Gymnasiums	55° to 65° F.
Officers, reception rooms, teachers' rooms, re- tiring rooms.....	65° to 70° F.
Corridors	60° to 70° F.
Play rooms, lunch rooms, locker rooms, wash rooms, dressing-rooms and coat rooms....	60° to 68° F.
Toilet rooms	55° to 68° F.

For rooms not named the temperature range shall be 60° to 70° F. according to use.

This article shall not apply to outdoor school rooms termed "open air" school rooms. An accurate thermometer shall be provided and remain set and maintained at a height of 5 ft. from the floor against an inside wall of each class, recitation, study and lecture room. One such thermometer shall be placed and maintained in each laboratory, domestic science, and manual training room and at least two such thermometers in each auditorium, assembly room and gymnasium. Provide proper insulation between thermometer and wall.

Article V—Special Exhaust Ventilation.

There shall be provided for all laboratories, domestic science rooms or other rooms where gases, fumes or other special impurities are released in quantities tending to injure the health of the occupants, suction devices that shall remove such gases, fumes and other impurities from said laboratories, domestic science rooms or other rooms at or near the point of origin. When the Department of Health shall deem it necessary proper hoods and ducts connected with exhaust fan or fans of sufficient capacity, and operating at sufficient pressure shall be provided to remove such impurities. Said fan or fans shall be kept running constantly while such impurities are being generated or released and shall discharge at a point above the roof or otherwise as may be necessary to safeguard the fresh air supply for the building from contamination and prevent any public nuisance.

Article VI—Special Service Rooms.

General locker rooms, coat rooms, dressing-rooms and wash rooms shall have exhaust ventilation equal to not less than 6 changes of air per hour except where windows of such rooms open directly to the outside air and are at least equal in area to one-eighth of the floor area of the room. In such cases the exhaust ventilation requirement may be modified under discretion of the Department of Health.

Article VII—Toilet Room Ventilation.

See Toilet Room Ventilation, Section 1, Article IX.

Article VIII—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with the requirements of the

Health, Fire, Building or Electrical Departments may be used both to warm the air supply for ventilation and to provide heat by direct radiation.

Article IX—Temperature Control.

Temperature control, preferably of an automatic type, shall be required for all heated and ventilated rooms. The temperature regulator, whether automatic or hand control, shall be so arranged that its operation will not decrease the required volume of air supply for ventilation.

Article X—Moving Picture Machines.

Where facilities are given for moving picture machines, all ventilation and fire protection shall conform to Section IV, Article VI, and accompanying suggestions.

Article XI—Gravity Indirect Systems.

Gravity indirect heating and ventilating systems of approved design meeting the general requirements of this Section II may be accepted for small school houses not exceeding eight class rooms in localities where proper motive power for positive or mechanical ventilation is lacking, provided such gravity systems shall, with room temperatures maintained at 70° F. and a difference of 40° F. between the temperature of the outside air and that of the air entering the room at the warm air inlet, be capable of supplying at least 30 cu. ft. of air per minute for each pupil accommodated in the room or rooms.

GENERAL SUGGESTIONS FOR SCHOOLS AND COLLEGES

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters

are made in Section I, Articles XI, XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge to encourage the installation of liberal and high-class equipment in our schools for the public inspiration as well as for the health and comfort of the occupants.

In Article I, minimum floor space and volumes for laboratories, manual training and domestic science rooms were omitted because of the wide diversity of existing practice. Values which seem reasonable are:

Floor space, per occupant, 25 sq. ft.; volume, per occupant, 300 cu. ft.

In Article II, "air from an uncontaminated source" comprehends a supply of air, either normally pure as it enters the building or purified by some approved method before being distributed to the rooms in the building.

Elimination of dust from the air supply by means of air filters or air washers is desirable even under the best conditions and is absolutely imperative under some conditions of especially dusty air supply.

The controlling of relative humidity, within the range of 35 per cent. to 50 per cent. is desirable, wherever possible.

Rules for opening class room windows, under proper supervision, during recess periods are often valuable.

Strong emphasis is placed on the need of having the administrative feature of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further

urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation to require approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washers for air supply where the same is especially dust laden; to require fans in the auditorium to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the general legal ventilation requirements.

The Committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Section I, Articles XIII and XIV of this report (which have been of great benefit in the City of Chicago), or clauses to the same effect, be included in every ventilation law.

SECTION III

Factories

(Special Minimum Heating and Ventilation Requirements
Applying to all Classes of Factories and Work Rooms.
Supplementary to Section 1).

Definition.

Any building or room where persons are at work or employed in the manufacture, assembling or repairing of goods or materials which are not for their own family consumption or personal use shall be deemed a "factory" for the purposes of this Section.

General Requirement.

The owner or lessee or tenant or agent of a building used as a factory or in which a factory work room or work rooms are located, or the owner or lessee or tenant or agent of any work room in any building used for factory purposes, shall provide and maintain for every work room thereof and for all allied service rooms in connection therewith (such as office, stock, sorting, shipping, wash, dressing, locker and toilet rooms) good and sufficient ventilation and healthful temperature and humidity conditions at all times during working hours.

Article I—Space Per Occupant.

A minimum space of 250 cu. ft. per occupant shall be provided in all work rooms and no work room, of which occupancy is taken after the date of issuance of this provision, shall have less than a clear height of 10 ft.

Article II—Air Supply Per Occupant.

A positive supply of outdoor air from an uncontaminated source shall be provided for the work room at all times during working hours, and the quantity of this supply of outdoor air shall be based upon a minimum requirement of 1,500 cu. ft. per hour per occupant introduced in such a manner as to fully meet the requirements of Articles III and IV.

Where the space per occupant is less than 1,000 cu. ft., or the window area, opening directly to out of doors, is less than 8 sq. ft. per occupant, a positive air supply shall be furnished by mechanical or other means.

Article III—Air Distribution.

The distribution of the fresh air supplied shall be so arranged as to maintain the temperature requirements without uncomfortable drafts, or any direct draft lower than 60° F. in occupied spaces. (See exceptions under the following Article IV.) One test of proper air supply and distribution will be that the CO₂ content in any occupied part of a work room shall not at any time exceed 10 parts in each 10,000 parts of air, based upon tests of air taken in a zone of 3 ft. to 6 ft. above the floor line in any part of the occupied spaces. (See exceptions in Section I, Art. III.)

Article IV—Temperature.

The temperature of the air in any work room shall, at all times during working hours, be maintained throughout the actual working spaces, within the range of 60° F., to 72° F., depending upon the class of work and workers except when the outside temperature is sufficiently high that artificial heating in the building is not required or when the particular class of work requires or makes ad-

visible other temperatures that may be allowed by the Department of Health.

The temperature of the air in offices shall be maintained during occupancy within the range of 65° to 70° F.; in wash, dressing and locker rooms during working hours, 60° to 70° F.; and in toilet rooms 55° to 60° F.

Accurate thermometers shall be provided, set and maintained at a height of 5 ft. from the floor of all work rooms at least one thermometer for every 2,500 sq. ft. of floor area. Provide proper insulation between thermometer and wall.

Article V—Heat Sources.

Any heat source which does not contaminate the air and which does not conflict with requirements of the Health, Fire, Building or Electrical Departments, may be used both to warm the outdoor air supply and to provide heat by direct radiation.

Article VI—Special Service Rooms.

Locker, wash, dressing and coat rooms shall be ventilated in a manner approved by the Department of Health. See Section I, Article VIII.

Article VII—Removal of Injurious Substances by Mechanical Exhaust, or Other Practical and Positive Means.

Where dust, fumes, gases, vapors, odors, fibres or other impurities are created or released in the course of a business or process carried on in any work room or other place in quantities tending to injure the health of the occupants, there shall be provided canopies, hoods or other special devices, connected with exhaust fan or fans of sufficient capacity and operated at sufficient pressure to remove such impurities at their point of origin. Such fans shall be

kept running constantly while impurities are being generated or released, and shall discharge at a point above the roof or otherwise if so directed by the Department of Health and be provided with dust collectors or separators as may be required to safeguard the fresh air supply of the building or adjacent buildings and prevent nuisance in the neighborhood. If practical and positive means, other than mechanical exhaust, can be devised for keeping these impurities from the air, such means may be used when formally approved by the Department of Health.

Whenever the amount of air exhausted by suction devices to meet the above requirements exceeds the amount of air supply required for ventilation, the air supply for ventilation shall be increased sufficiently to prevent undue air in-leakage.

Article VIII—Excessive Temperature and Humidity.

If, owing to the nature of the work done or the process carried on in a work room or any occupied space in any factory, excessive heat or humidity is caused therein, sufficient to be injurious to health, there shall be provided and maintained special means or appliances to reduce and control such excessive heat according to the requirements of Article IV, and the relative humidity shall not be permitted to exceed 65 per cent. except when outside weather conditions prevent or when said rooms are used for special purposes which, according to the Department of Health require or make advisable other humidities.

Article IX—Filters and Air Washers.

If in the opinion of the Department of Health the air supply to any building is deemed impure or especially dust laden, filters, air washers or other appliances, satisfactory to the Department, must be provided.

Article X—Air Contamination from Gas Burners.

Where artificial or natural gas is burned in any occupied work room, it shall be the duty of the Department of Health to inspect, and said Department can require special or additional ventilation to overcome any objectionable condition.

Article XI—Toilet Room Ventilation.

See Toilet Room Ventilation, Sec. I, Article IX of the general heating and ventilating requirements.

GENERAL SUGGESTIONS FOR FACTORIES

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters are made in Section I, Articles XI, XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of these regulations in charge to encourage the owners and operators of said factories to provide as comprehensive, liberal and high-class equipment as possible, to catering to the comfort, health and efficiency of the employees.

Elimination of dust from the air supply by means of air filters or air washers is desirable under the best conditions, and is absolutely imperative under some conditions of especially dusty air supply.

The controlling of relative humidity, within the range of

35 per cent. to 50 per cent. is desirable, wherever possible.

Rules for airing all work rooms during the noon hour by means of open windows is, under proper supervision, often valuable.

Strong emphasis is placed on the need of having the administrative features of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given reasonable latitude by legislation to establish rulings within the law requiring approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washers, for air supply where the same is especially dust laden; to require fans in special places to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the legal ventilation requirements.

Definite penalties, such as fines for minor offenses, up to a closing of the establishment for important or repeated violations, are indispensable to get practical results.

The Committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Section I, Articles XIII and XIV of this report (which have been of great benefit in the City of Chicago), or clauses to the same effect be included in every ventilation law.

SECTION IV

Theatres

(Special Minimum Requirements Applying to all Classes of Theatres and Motion picture Houses. Supplementary to Section I).

Article I—Space Per Occupant (new places).

a. A minimum of 43-5 sq. ft. (must be at least 33 in. back to back of seats by at least 20 in. width of seat) of floor area as a seating space per occupant, exclusive of aisles and public passageways, shall be provided in the audience hall.

b. A minimum of 90 cu. ft. of air space, per occupant, shall be provided in the audience hall.

c. Aisles shall have in the aggregate a width of not less than 20 in. for each 100 seating capacity, and for fractional parts of 100, a proportionate part of 20 in. shall be added. No aisles shall have a width of less than 30 in.

Article I-A—Space Per Occupant (existing places).

a. A minimum of 41-3 sq. ft. (preferably 32 in. back to back of seats by 19½ in. width of seat) of floor area as a seating space per occupant, exclusive of aisles and public passageways, shall be provided in the audience hall.

b. A minimum of 80 cu. ft. of air space, per occupant, shall be provided in the audience hall.

c. Aisles shall have in the aggregate a width of not less than 20 in. for each 100 seating capacity, and for fractional parts of 100, a proportionate part of 20 in. shall be added. No aisles shall have a width of less than 30 in.

Article II—Air Supply Per Occupant (new places).

A positive supply of outdoor air from an uncontaminated source shall be provided for the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based upon a minimum requirement of 1,200 cu. ft. per hour per occupant.

Article II-A—Air Supply Per Occupant (existing places).

A positive supply of outdoor air from an uncontaminated source shall be provided for the audience hall at all times while the show place is open to the public, and the quantity of this positive supply of outdoor air shall be based upon a minimum requirement of 1,000 cu. ft. per hour per occupant.

Article III—Air Distribution (new places).

The distribution of the supplied outdoor air in the audience hall shall be so arranged as to maintain the temperature requirement without uncomfortable drafts, or any draft lower than 60° F., and as one test of proper supply and distribution, it shall be required that the CO₂ content in any part of such audience hall shall not at any time exceed 10 parts in each 10,000 parts of air, based upon tests of air taken in a zone from 3 ft. to 6 ft. above the floor line in the occupied spaces.

Article III-A—Air Distribution (existing places).

The distribution of the supplied outdoor air in the audience hall shall be so arranged as to maintain the temperature requirement without uncomfortable drafts, or any draft lower than 60° F., and as one test of proper supply and distribution, it shall be required that the CO₂ content

in any part of such audience hall shall not at any time exceed 12 parts in each 10,000 parts of air, based upon tests of air taken in a zone from 3 ft. to 6 ft. above the floor line in the occupied spaces.

Article IV—Temperatures (both new and existing places).

The temperature of the air in the audience hall during period of occupancy shall be maintained at all times throughout all occupied spaces within the range of 62° F. to 70° F., except when the outside temperature is sufficiently high that artificial heating in the building is not required.

The temperature of the air in dressing-rooms, smoking-rooms, stage, ante-rooms, ticket offices, toilets and any occupied spaces other than the auditorium, shall be maintained as the special use thereof makes desirable within the range covered by Section 1, of the general ventilation requirements.

Article V—Heat Sources (both new and existing places).

Any heat source which does not contaminate the air and which does not conflict with the requirements of the Health, Fire, Building or Electrical Departments may be used both to warm the outdoor air supply and to provide heat by direct radiation.

All stoves are prohibited and all gas heaters except when furnished with ample protection and adequate means for the removal of products of combustion are prohibited.

Article VI—Machine Booth Ventilation (both new and existing places).

Enclosures or booths for the motion picture machines shall be provided with exhaust ventilation having sufficient capacity to remove at all times not less than 60 cu. ft. of

air per minute through a one-machine booth, not less than 90 cu. ft. of air per minute through a two-machine booth, and not less than 120 cu. ft. of air per minute through a three-machine booth. See General Suggestions for theatres for further details.

Where picture machines, films and their equipment are passed as fireproof by the National Board of Fire Underwriters, the Department of Health may, at its discretion, modify the booth requirements.

Article VII—Air Exhaust System.

Attention is called to the general ventilation requirements for Special Service Rooms, Section I, Article VIII.

Article VIII—Toilet Room Ventilation (both new and existing).

See Toilet Room Ventilation, Section 1, Article IX.

GENERAL SUGGESTIONS FOR THEATRES

General questions, such as inspection, method of enforcing the requirements, penalties for non-compliance, etc., are left largely for each state, city or town to determine, although some pertinent suggestions covering these matters are made in Sec. I, Arts. XI, XII, XIII and XIV. *Inspection, method of enforcing and penalties are vitally important and should have careful consideration.*

It should be especially noted that the foregoing regulations call for a minimum of all requirements as compulsory, and that it should be the aim of the administrative department having enforcement of the regulations in charge, to encourage the owners and managers of motion-picture shows to provide as comprehensive, liberal and high-class equipment as possible, with a view to catering to the comfort and health of the patrons and thus add to

the popularity of the show place as compared with others which have barely come within the legal requirements.

The 80 cu. ft. of air space per occupant, allowed by the recommended regulations for "existing places" has been arrived at as an extreme minimum cubic space which should be allowed per individual when considering difficult cases of old established places. Ninety cu. ft. of air space per occupant is considered minimum for "new places" and should be increased wherever possible.

A mechanical system of exhaust ventilation is desirable for the auditorium of a theatre in addition to the air supply system, but a mechanical system of exhaust ventilation is not made compulsory except where it may be necessary to meet the temperature and air distribution requirements.

The requirement for machine booth ventilation may be fulfilled by having a number of small metal screened openings (equipped with special dampers and automatic appliances with fusible link to automatically close tight in case of fire in the booth) on the sides of the booth near the bottom, aggregating 180 sq. in. for a one machine booth, 210 sq. in. for a two-machine booth, and 240 sq. in. for a three-machine booth, and a metal or other fire-proof flue extending from the top or the side near the top of the booth and carried to a proper place of discharge outdoors. The size of this special fireproof vent flue shall be not less than 95 sq. in. clear area for a one-machine booth, not less than 120 sq. in. clear area for a two-machine booth, and not less than 144 sq. in. clear area for a three-machine booth, and in addition it shall be provided with an adjustable damper, operated from the booth and equipped with an appliance containing a fusible link or other device to operate so as to automatically open the damper wide in case of fire in the booth. Provide a metal duct equal in size to the special exhaust duct referred to for the different

sizes of booths and connecting from out-of-doors to the bottom or lower part of booth for the introduction of out-door air directly to the booth. This duct shall pitch from the booth downward to the outside wall of the building, shall be provided at the inlet with proper louvres or weather protection hood, and shall have an adjustable damper near the booth, said damper to be controlled from within the booth and to be independently equipped with an appliance containing a fusible link or other device to operate so as to automatically close in case of fire in the booth. The machine booth ventilation shall be kept in operation at all times when the booth is in use.

Where picture machines, films and their equipment are passed as fireproof by the National Board of Fire Underwriters, the Department of Health may, at its discretion, modify the booth requirements.

Elimination of dust from the air supply by means of air filters or air washers is desirable even under the best conditions and is absolutely imperative under some conditions of especially dusty air supply. This question is dealt with by suggestion in the following general clauses.

The controlling of relative humidity, within the range of 35 to 50 per cent. is desirable, wherever possible, but the committee decided to omit from the regulations any humidity requirement in theatres.

Strong emphasis is placed on the need of having the administrative feature of legislation, of the kind here advocated, placed in the control of a responsible department, such as a State Department of Health in the case of villages, and a Municipal Department of Health or some other responsible municipal department for cities. It is further urged that such department be supplied with a special inspector or inspectors, experienced in heating, ventilation and sanitation, and that such department be given

reasonable latitude by legislation to require approval of plans preceding installation; to require special extra equipment for special cases, such as dust filters or air washers for air supply where the same is especially dust laden; to require fans in the auditorium to keep the air in motion where air distribution is deficient, etc., it being made clear in the legislation that such latitude should in no case include the right to reduce the general legal ventilation requirements.

Definite penalties, such as fines for minor offenses, up to a suspension or revoking of licenses for important or repeated violations, are indispensable to get practical results.

The committee recommends that the clauses relating to the power of entry and closure by authorized officers as stated in Sec. I, Arts. XIII and XIV of this report (which have been of great benefit in the City of Chicago) or clauses to the same effect be included in every ventilation law.

GENERAL NOTES INSERTED BY THE COUNCIL OF THE HEATING ENGINEER'S SOCIETY

Our society has, from time to time, been asked by State and legislative bodies and by public health and other organizations to furnish suggestions that will be of value in drawing up legislation regarding the heating and ventilation of buildings, and this committee report presents general suggestions intended to be both conservative and practical.

Attention is called to the fact that the committee report deals with old buildings as well as new. The city of Chicago makes its ventilation laws apply to both old and new buildings with good results, yet there are some who object

to making legal requirements apply to buildings other than new buildings. If in any case the following suggestions are used to apply to new buildings, only, some modified requirements, as near the requirements for new buildings as possible, should, in the interests of public health, be enforced for existing buildings.

The subject of ventilation embraces many variable factors (especially in the case of factory work rooms) and the committee has made its suggestions cover the general features in heating and ventilation most essential to the public health and decency in such a manner as to reasonably well protect the public with the least possible requirement for equipment; and has suggested practical conditions that should be maintained without unnecessarily limiting the method of obtaining the results.

It is often desirable to have humidifying apparatus and humidity control, but, because of the expense of such equipment, humidity control (except as to keeping down excessive humidity) has been omitted from the suggested requirements.

It is important to note that the suggestions given in the report are for average localities in the United States, taking New York, Boston and Chicago as examples, and that some modifications may be desirable to suit localities like the Pacific Coast, Gulf States and Alaska, or localities of unusually high altitude and dry climates.

Specific rules, not included herein, will be needed covering details of installation and operation, such, for example, as have been formulated and adopted with excellent results by the department of health in the City of Chicago and the Industrial Commission of the State of Wisconsin.

The removal from work rooms of objectionable dusts, fumes, gases, vapors, odors, fibres and other impurities created in manufacturing processes, covered by general

requirements in the report, is vitally important and will require specific rules that are practical and that may be widely applied. Space conditions per occupant should, under these conditions, be most liberal. Some good rules for removal of dusts, etc., from manufacturing establishments have been drawn up by the 1915 Industrial Board of the New York State Department of Labor and by the Industrial Commission of Wisconsin:

The administrative features of enforcing general ventilation laws are extremely important, and experienced and capable engineers are necessary as inspectors and as advisors to the administrative department.

Good laws are often made almost useless for the want of proper administration and likewise inadequate laws are sometimes largely compensated by efficient and wise administration.

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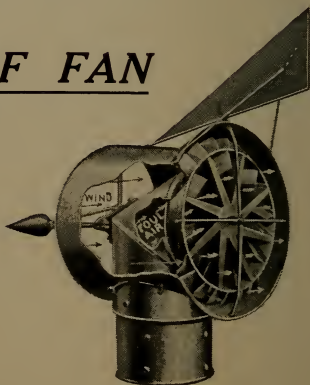
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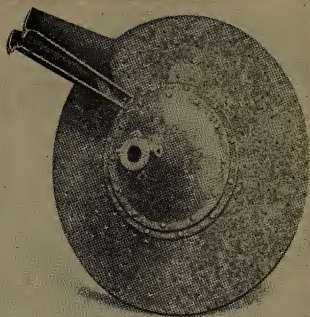
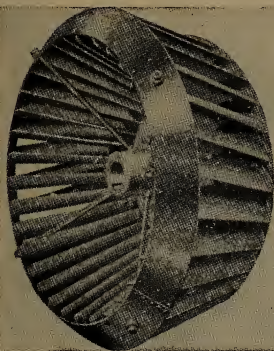
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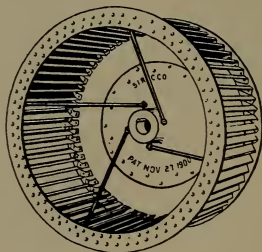
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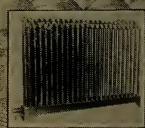
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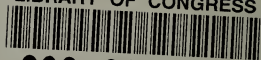
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